

A critical review of the distribution of the endangered European earth-borer beetle *Bolbelasmus unicornis* (Coleoptera, Geotrupidae), with new records from 13 countries and observations on its bionomy

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Abstract

The distribution of *Bolbelasmus unicornis* (Schrank, 1789) is critically reviewed throughout its range with emphasis on the Czech Republic and Slovakia. The species has been reliably recorded from 377 localities in 19 countries. New records are given from 152 localities of Bulgaria, Czech Republic, Germany, Hungary, Italy, Moldova, Poland, Romania, Serbia, Slovakia, Turkey, and Ukraine. For Germany, the species is recorded for the first time in 54 years. The occurrence of the species in Switzerland is confirmed by two historical specimens from Zürich. The only known historical specimen labelled “Kaukasus” is given, which could originate from Russia, where this species has not been recorded before (however, confusion of the locality label cannot be ruled out). All published faunistic data from across the range are presented here in full, in several cases supplemented by details subsequently obtained by the author. Distribution maps are compiled separately for the Czech Republic and Slovakia, and for the entire range. A separate map is also available for Hungary, where approximately one-third of the known localities are located. Statistical data concerning the flight activity of adults, seasonal dynamics for part of the distribution area, details of records and notes on the bionomy and ethology of the species are provided. Possible feeding strategies for adults and larvae of *B. unicornis* are discussed, as well as current knowledge of the natural history of various representatives of the subfamily Bolboceratinae. A monitoring method for the species is proposed.

Keywords

Asia Minor, Bolboceratinae, ethology, Europe, Palearctic realm, zoogeography

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Introduction

Bolbelasmus unicornis (Schrank, 1789) is a European species of earth-borer beetle extending into the western Asian part of Turkey with the centre of distribution in the

Pannonian Basin (see Faunistic records and Fig. 18). It is a medium-sized bolboce-ratine which was the subject of considerable interest to the insect collectors as early as the 19th century because of its interesting and attractive appearance (for male and female habitus see Figs 1–3, 21). In literature, the body length of adults is reported to be 12.0–15.0 mm (Savchenko 1938; Endrődi 1956; Panin 1957; Mikšić 1958, 1960; Medvedev 1965; Machatschke 1969; Baraud 1992; Hůrka 2005; Ballerio et al. 2014). According to measurements taken during this study on ca. 800 specimens, the body length of this species ranges between 9.5–14.5 mm. *Bolbelasmus unicornis* is considered an endangered species with bioindicator significance throughout its range (see Habitat preferences). For this reason, it has been listed as a species of special conservation in many European countries. At the instigation of Slovakia, it has been included in Annexes II and IV of the Habitat Directive of the European Union (species in need of strict protection). As very few faunistic records are known from most countries, each new record is critically important to increase our knowledge to implement appropriate conservation strategies for the species. For more than 50 years the species has not been recorded in France, Slovenia, Bosnia and Herzegovina, Albania, and Moldova. It is probably extinct in France, Switzerland, Poland, and the Czech Republic.

The species was described as *Scarabaeus unicornu* by Schrank von Paula (1789) and subsequently as *S. aeneas* by Panzer (1793a). Since the end of the 18th century, the species was often confused with *Scarabaeus quadridens* Fabricius, 1781 from India and later synonymised with it (Panzer 1793b, 1795, 1802; Illiger 1798; Duftschmid 1805; Sturm 1805, 1843; Schönherr 1806; Skrimshire 1812; Dejean 1821, 1833, 1836; Curtis 1829a, b, 1837; Stephens 1829, 1830, 1839; Eichwald 1830; Laporte de Castelnau 1840; Heer 1841). However, Illiger (1800) had already assumed that these were two distinct species. It was only Klug (1843) who separated the two species from each other, however, later authors (e.g., Erichson 1847; Gaubil 1849; Kiesenwetter and Schaum 1849; Redtenbacher 1849, 1858, 1874; Westwood 1852; Oechsner 1854; Lacordaire 1856; Calwer 1858; Fuss 1858; Gerstaecker 1863; Stierlin and Gautard 1867; Gemminger and Harold 1869; Mulsant and Rey 1871; Bertolini 1872; Jäger 1884; Seidlitz 1891; Luigioni 1929) continued to list the name *quadridens* among synonyms and often ascribed authorship of this species name to Panzer (1795). The same mistake was reported in both editions of the Catalogue of Palearctic Coleoptera (Král et al. 2006; Nikolajev et al. 2016).

Given its secretive lifestyle and lack of knowledge of effective collecting methods, the distribution and bionomy of *B. unicornis* are poorly known. Adults spend most of their time underground, with above-ground activity limited to short flight periods when they fly very close to the ground just after sunset (see Natural history of Bolboceratinae in this study). Nothing is known about the immature stages and the diet of adults and larvae. However, some authors assumed that both adults and larvae feed on hypogeous fungi (e.g., Sajó 1910a, b; Ohaus 1929; Roubal 1936; Koch 1989; Bratek et al. 1992; Merkl 2003, 2014, 2015; Náđai 2006). Adults, like in other members of the genus *Bolbelasmus*, are able to stridulate loudly, a fact first mentioned by Ghiliani (1847). Individuals of *B. unicornis* produce a wide range of sounds, varying in intensity and other characteristics depending on whether it is in response to a disturbance or part of their normal

activities (pers. obs.). In the congeneric species *B. gallicus* (Mulsant, 1842) and *B. brancoi* Hillert & Král, 2016, this ability has also been recorded in larvae (Verdú et al. 1998: *B. brancoi* listed as *B. bocchus* (Erichson, 1841); Verdú et al. 2004; Rahola Fabra 2004).

Materials and methods

The nomenclature used in this research follows Howden et al. (2007), Smith (2009), and Nikolajev et al. (2016), with corrections according to Bouchard and Bousquet (2020) and Ziani et al. (2021). The taxon *Bolbocerodema* Nikolajev, 1973 is considered here to be a subgenus of the genus *Bolbocerosoma* Schaeffer, 1906, in accordance with Krikken (1979) and Smith (2009). The concept of Bolboceratinae as a subfamily of Geotrupidae is consistent with Lawrence and Newton (1995), Verdú et al. (2004), Howden et al. (2007), and Nikolajev et al. (2016).

Faunistic records from the Czech Republic and Slovakia are divided into paragraphs beginning with a number representing the code of the faunistic square that refers to the Central European grid for mapping fauna and flora (Fig. 9; also see e.g., Zelený 1972; Novák 1989; Pruner and Míka 1996; Kolouch 2002). For other countries, the records are divided into paragraphs according to the largest superior administrative units or traditional regions. The countries, the faunistic square codes and the administrative units/traditional regions are ordered according to their geographical positions from east to west and from north to south. A question mark at the beginning of a faunistic record indicates dubious data. For protected areas in the Czech Republic and Slovakia, three acronyms are used in the text: **PP** – Přírodní památka (= Natural Monument), **PR** – Přírodní rezervace (= Nature Reserve), and **NPR** – Národní přírodní rezervace (= National Nature Reserve). The abbreviation **FSLG** means flying slowly low above the ground. The following acronyms are used for time zones: **CEST** – Central European Summer Time, and **EEST** – Eastern European Summer Time. The abbreviation representing a collector/observer (see list below) with no further details mentioned means the collector and depository are identical (leg. and coll.). All details regarding observations of adults of *B. unicornis* (in particular their flight activities) were provided by the listed participants of these observations. The material has been identified by the author, the curators of the collections, or the observers and collectors listed.

The following systems are used to transliterate cited literature and geographical or personal names in the Cyrillic and Armenian scripts: BGN/PCGN 2013 Agreement for Bulgarian, BGN/PCGN 1947 System for Russian, BGN/PCGN 2005 Agreement for Serbian, BGN/PCGN 2019 Agreement for Ukrainian, and BGN/PCGN 1981 System for Armenian.

For the distribution map of the Czech Republic and Slovakia, the records are divided into three time periods: the records before 1960, records between 1960–1999, and records after 1999 (Fig. 9). This map was compiled by manually placing the circles in the grid map used for faunistic research in these countries in standard free graphics software. For the distribution maps of Hungary and Europe, the following time peri-

ods are used: records before 1950, records between 1950–1999, and records after 1999 (Figs 12, 18). These maps were created using the Google Maps web application by inserting specific GPS coordinates into the system. GPS coordinates were obtained from collectors or providers of the sightings listed for each faunistic record. In cases where the exact GPS coordinates were not known (e.g., records from literature), the midpoint GPS coordinates of the village, town, county, or area were used.

Statistics on flights of adults were compiled for eight localities (seven Slovak and one Serbian), for which detailed data were available (Tables 1–8). A table with the same statistics was also created for the published data from the Italian locality of Cordenons (Table 9; Glerean and Stefani 2019).

The graph of seasonal dynamics was generated with data obtained from countries of the Pannonian Basin for which data on a minimum of 30 specimens were available (Fig. 19).

The dates of Panzer's works are adopted from Bousquet (2016) and Alonso-Zarazaga and Evenhuis (2017). Panzer (1793a) is cited according to Sherborn (1902), Hillert et al. (2016) and Löbl and Löbl (2016). Kuthy's book (1898) is cited following Bousquet (2016), but with some modifications.

Acronyms for the collectors, observers, and institutes

ABC	Attila Balázs, Čamovce, Slovakia
ABZ	Andrii Ivanovych Bachynskiyi (Андрій Іванович Бачинський), Zalishchyky, Ukraine
ADW	Alexander Dostal, Vienna, Austria
AGB	András Górh, Biatorbágy, Hungary
AHB	Adam Hergovits, Bratislava, Slovakia
AKB	Attila Kotán, Budapest, Hungary
AMK	András Máté, Kecskemét, Hungary
APC	Alexandru-Mihai Pintilioaie, Comănești, Romania
APE	Attila Pál, Érd, Hungary
APO	Antonín Peutlschmid, Olomouc, Czech Republic
ARC	Adrian Ruicănescu, Cluj-Napoca, Romania
ASH	Aleš Sedláček, Hranice, Czech Republic
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AUP	Ákos Uherkovich, Pécs, Hungary
BBO	Boris Bubeník Sr., Ostrava, Czech Republic
BCK	Csaba Bán, Kecskemét, Hungary
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BJO	Boris Bubeník Jr., Ostrava, Czech Republic
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CBK	Csaba Bíró, Kecskemét, Hungary
CKZ	Csaba Kutasi, Zirc, Hungary
CMI	Cosmin-Ovidiu Manci, Iași, Romania
CSB	Csaba Szabóky, Budapest, Hungary
CSS	Csaba Szinetár, Szombathely, Hungary
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ZBP	Zsófia Mocskonyi Bércesné, Pomáz, Hungary
ZCP	Zdeněk Čermák, Prostějov, Czech Republic
ZDP	† Zdeněk Doležal, Plzeň, Czech Republic
ZKB	Zoltán Körmendy, Budapest, Hungary
ZKM	Zdeněk Kraus, Mikulovice (near Znojmo), Czech Republic
ZLB	Zdeněk Laštůvka, Brno, Czech Republic
ZVP	Zdeněk Vancl, Police nad Metují, Czech Republic

BNMS	Brukenthal National Museum, Sibiu, Romania
BZLA	Biologiezentrum Linz, Austria
CMZC	Croatian Natural History Museum, Zagreb, Croatia
CUIR	Alexandru Ioan Cuza University, Iași, Romania
ETHZ	Entomological collection of the Swiss Federal Institute of Technology, Zürich, Switzerland
FGBI	Franziskaner Gymnasium Bozen, Bolzano, Italy
FMNH	Finnish Museum of Natural History LUOMUS, University of Helsinki, Helsinki, Finland
GANM	“Grigore Antipa” National Museum of Natural History, Bucharest, Romania
GUNU	Nizhyn Gogol State University, Nizhyn, Ukraine
HNHM	Hungarian Natural History Museum, Budapest, Hungary
IECA	Institute of Entomology, Biology Centre of the Czech Academy of Sciences, České Budějovice, Czech Republic
IZCM	Institute of Zoology of the Academy of Sciences of Moldova, Chișinău, Republic of Moldova
JHIS	Jovan Hadži Institute of Biology of the Research Centre of the Slovenian Academy of Sciences and Arts, Ig, Slovenia
LKKA	Landesmuseums für Kärnten, Klagenfurt am Wörthersee, Austria
MCAS	Museo Civico Archeologico e di Scienze Naturali “Federico Eusebio”, Alba, Italy
MCZR	Museo Civico di Zoologia, Rome, Italy
MFSN	Museo Friulano di Storia Naturale, Udine, Italy
MHKC	Museum of Eastern Bohemia in Hradec Králové, Hradec Králové, Czech Republic
MHNG	Muséum d’histoire naturelle de Genève, Geneva, Switzerland
MIZP	Museum and Institute of Zoology of the Polish Academy of Sciences, Warsaw, Poland
MJMC	Muzeum jihovýchodní Moravy ve Zlíně, Zlín, Czech Republic
MKPC	Muzeum Komenského v Přerově, Přerov, Czech Republic
MMBC	Moravian Museum, Brno, Czech Republic
MNBG	Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Museum für Naturkunde, Berlin, Germany
MMGH	Mátra Museum of the Hungarian Natural History Museum, Gyöngyös, Hungary
MMSH	Móra Ferenc Museum, Szeged, Hungary
MNFI	Natural History Museum “La Specola”, Florence, Italy
MNHN	Muséum national d’Histoire naturelle, Paris, France
MNSA	Museum Niederösterreich, Sankt Pölten, Austria
MPGU	Moscow Pedagogical State University, Moscow, Russia
MSNB	Museo di Scienze Naturali dell’Alto Adige, Bolzano, Italy
MSNG	Museo Civico di Storia Naturale “Giacomo Doria”, Genoa, Italy
MSNM	Museo Civico di Storia Naturale, Milan, Italy

MTDG	Senckenberg Naturhistorische Sammlungen, Museum für Tierkunde, Dresden, Germany
MUSE	Museo delle Scienze, Trento, Italy
MZLU	Biological Museum, Lund University, Lund, Sweden
MZSF	Musée zoologique de l'université et de la ville de Strasbourg, Strasbourg, France
NHMB	Naturhistorisches Museum Basel, Switzerland
NHMD	Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark
NHMK	State Natural History Museum of V. N. Karazin Kharkiv National University, Kharkiv, Ukraine
NHML	Natural History Museum, London, United Kingdom
NHMU	National Science and Natural History Museum of the National Academy of Sciences of Ukraine, Kyiv, Ukraine
NHMW	Naturhistorisches Museum Wien, Vienna, Austria
NMAG	Naturmuseum Augsburg, Germany
NMBE	Naturhistorisches Museum Bern, Switzerland
NMCM	National Museum of Ethnography and Natural History, Chişinău, Republic of Moldova
NMEG	Naturkundemuseum Erfurt, Germany
NMPC	National Museum, Prague, Czech Republic
NMSB	National Museum of Natural History, Sofia, Bulgaria
PMSL	Slovenian Museum of Natural History, Ljubljana, Slovenia
RBIN	Royal Belgian Institute of Natural Sciences, Brussels, Belgium
RMNH	Naturalis Biodiversity Centre (formerly Rijksmuseum van Natuurlijke Historie), Leiden, Netherlands
SDEI	Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany
SIZK	I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine
SMLU	State Museum of Natural History, Lviv, Ukraine
SMNK	Staatliches Museum für Naturkunde Karlsruhe, Germany
SMNS	Staatliches Museum für Naturkunde Stuttgart, Germany
SMOC	Silesian Museum, Opava, Czech Republic
SNMS	Slovak National Museum–Natural History Museum, Bratislava, Slovakia
TLMF	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria
TMLS	Tekovské múzeum v Leviciach, Levice, Slovakia
UMJG	Universalmuseum Joanneum, Graz, Austria
VMHS	Vihorlatské múzeum Humenné, Slovakia
ZFMK	Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany
ZMNU	Zoological Museum of the Taras Shevchenko National University, Kyiv, Ukraine
ZMPC	Západočeské muzeum v Plzni, Plzeň, Czech Republic
ZINR	Zoological Institute of Russian Academy of Sciences, Saint Petersburg, Russia
ZSMG	Staatliche Naturwissenschaftliche Sammlungen Bayerns, Zoologische Staatssammlung, Munich, Germany

ZUDH Department of Nature Conservation, Zoology and Game Management,
University of Debrecen, Debrecen, Hungary

Systematics

Family: GEOTRUPIDAE Latreille, 1802

Subfamily: Bolboceratinae Mulsant, 1842

Tribe: BOLBELASMINI Iablokoff-Khnzorian, 1977

Genus: *Bolbelasmus* Boucomont, 1911

Subgenus: *Bolbelasmus* Boucomont, 1911

Species: *B. (B.) unicornis* (Schrank, 1789)

Faunistic records

Czech Republic

Published data

? **5354:** “Kummer” [= Hradčany near Mimoň], 1 ♂ flying in the evening, no other data (Kral 1915). Given that Kral listed several species from this locality which have never been confirmed, this record is not considered very reliable.

5756: Loučeň, 28.v.1905, 1 spec., [Augustin] Šrámek leg., Radek Červenka and Radek Dunda det., coll. NMPC (Juřena et al. 2008); note: this specimen was probably stolen from NMPC.

6865: “Kammberg b. Brünn” [probably Brno – Kohoutovice env., perhaps Kamený vrch hill], no other data (Horion 1958). This specimen should be deposited in Georg Frey’s collection in NHMB, but still on loan (Christoph Germann pers. comm., 2021).

7067: Hovorany, 6.v.1941, Jan Roubal leg. (Tesař 1957); Čejč, 28.v.1982, 1 ♀, J. Voříšek leg. (Juřena et al. 2008); Čejč env., Bílý kopec hill, [= PP Bílý kopec u Čejče, ca. 48°56'14"N, 16°59'E, ca. 200 m a.s.l.], July 1978, collector not specified (Juřena et al. 2008); Čejč env., “Mansonova step” [= “Manson’s steppe”, 48°55'32.1"N, 16°58'46.6"E], 1.vii.1987, 1 ♂, at light at 21.45 CEST, VJP (Juřena et al. 2008); 15.vi.1988, 1 ♂ FSLG at 21.45 CEST, ca. 20 °C, VJP (Juřena et al. 2008); 16.vi.1988, 1 ♂ flying ca. 10 cm above the ground at 21.52 CEST, ca. 10–12 °C, VJP leg., coll. DJP (Juřena et al. 2008); 17.–18.vi.1988, 2 ♀♀, JKJ (Juřena et al. 2008); 26.vi.1988, 1 ♀ was caught while trying to fly out from the grass, 21.55 CEST, MLS (Juřena et al. 2008); 29.vi.1999, 1 ♀ FSLG at 22.00 CEST, VKS (Juřena et al. 2008; Hillert et al. 2016); 3.vii.1999, 1 ♂ crawling on the footpath at 21.55 CEST, together with 1 ♂ of *Od. armiger*, RZJ leg., coll. JZJ (Juřena et al. 2008).

6568: Prostějov, [between 1878–1899, see Kolečka 1985] [Karel] Kyselý leg. (Kliment 1899); Záhoří near Prostějov [probably area SW of the town, near the village of Domamyslice (6568), or Na Záhoří hill (6468), ca. 600 m NE of the vil-

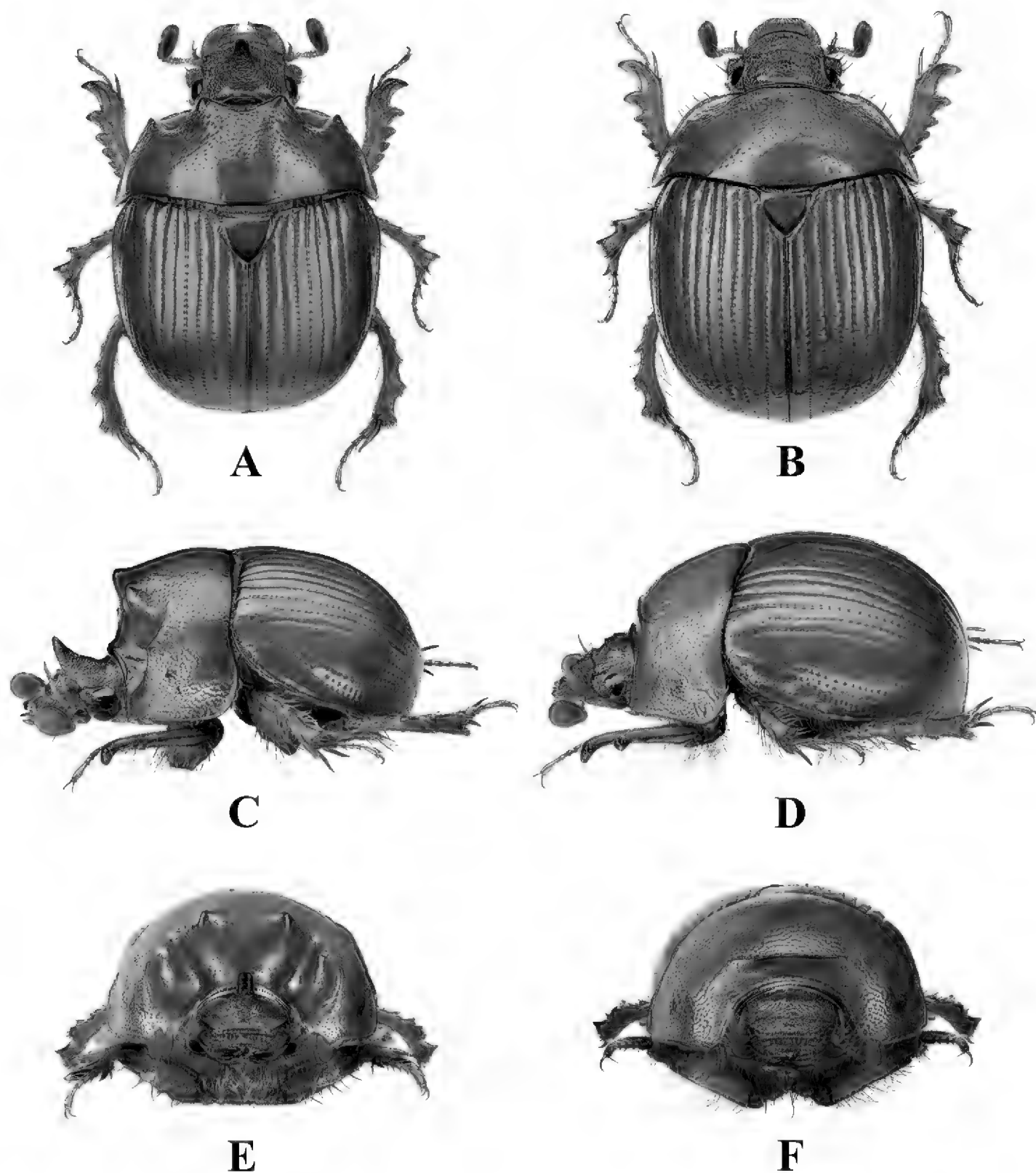


Figure 1. Habitus of *Bolbelasmus unicornis* **A** male, dorsal view **B** female dorsal view **C** male lateral view **D** female lateral view **E** male frontal view **F** female frontal view (photographs by Peter Kurina).

lage of Čelechovice na Hané – Kaple], [probably between 1878–1899], [Karel] Kyselý leg. (Fleischer 1930); “Proschnitz” [= Prostějov] (Schubert 1905; Zoufal 1922; Horion 1958); “Prossnitz” [= Prostějov], 1 ♂, [probably between 1878–1899], K[arel] Kyselý leg., coll. Georg Frey deposited in NHMB (Hillert et al. 2016).

? **6570:** Přerov env. [probably Bochoř near Přerov], no other data (Hudeček 1928, 1930); Bochoř, no other data (Hudeček 1937). These two records are very doubtful. Rusty-coloured specimens of *Od. armiger* (ab. *testaceus*) labelled as *Bolbelasmus unicornis*,



Figure 2. Habitus of *B. unicornis*, male, detail. Rarely, males have a frontal horn ending in two apices (photographed specimen: “Autriche” [= Austria], “coll. Reiber”, deposited in RBIN, photograph by Julien Lalanne, edited by Peter Kurina).

with black specimens of the same species, correctly labelled as *Odonteus armiger*, have been found in the Hudeček’s collection in MKPC; no specimens of *B. unicornis* were discovered in this collection (Jaroslav Žák pers. comm., 2016).

6870: “Ungarisch Hradisch” [= Uherské Hradiště] env., Morava River valley, no other data (Schlögl 1883).

Material examined and new observations

7067: Bořetice env., PR Zázmoníky, 48°56'06.9"N, 16°51'20.5"E, ca. 300 m a.s.l., 1.v.1998, 1 elytron excavated from loess soil, KRU obs.; Čejč env., “Květnatá step” [= so-called Květnatá steppe, northern part of the PR Čejkovické Špidlázky reserve], 48°55'22.0"N, 16°57'24.2"E, ca. 190 m a.s.l., 1.vii.1995, remains of a female excavated from a burrow of *Oryctolagus cuniculus*, KRU (VKS det., 15 October 2005); Čejč env., “Mansonova step” [= so-called “Manson’s steppe”], 48°55'32.1"N, 16°58'46.6"E, ca. 210 m a.s.l., 20.vi.1986, 1 ♀ FSLG after sunset, PCB; 17.vi.1988, 1 ♀ FSLG after sunset, PCB; 21.vi.1988, 2 ♀♀ FSLG after sunset, VKS; 27.vi.1988, 8 spec. FSLG after sunset (for a photograph of one of them see Král et al. 2018), together with hundreds of spec. of *Odonteus armiger* (Scopoli, 1772), VKS; 29.vi.1988, 2 spec. FSLG after sunset, VKS; 19.vi.1989, 1 ♀ FSLG after sunset, JTK; 16.vi.1995, 1 ♂ FSLG after sunset, VKS (for partial data on this record see Hillert et al. 2016); 17.vi.1995, 1 ♂ and 1 ♀ flying slowly ca. 10 cm above the ground after sunset just after the rain, VKS; Mutěnice [= Čejč env.], “Mansonka” [= Manson’s steppe], 2002, no

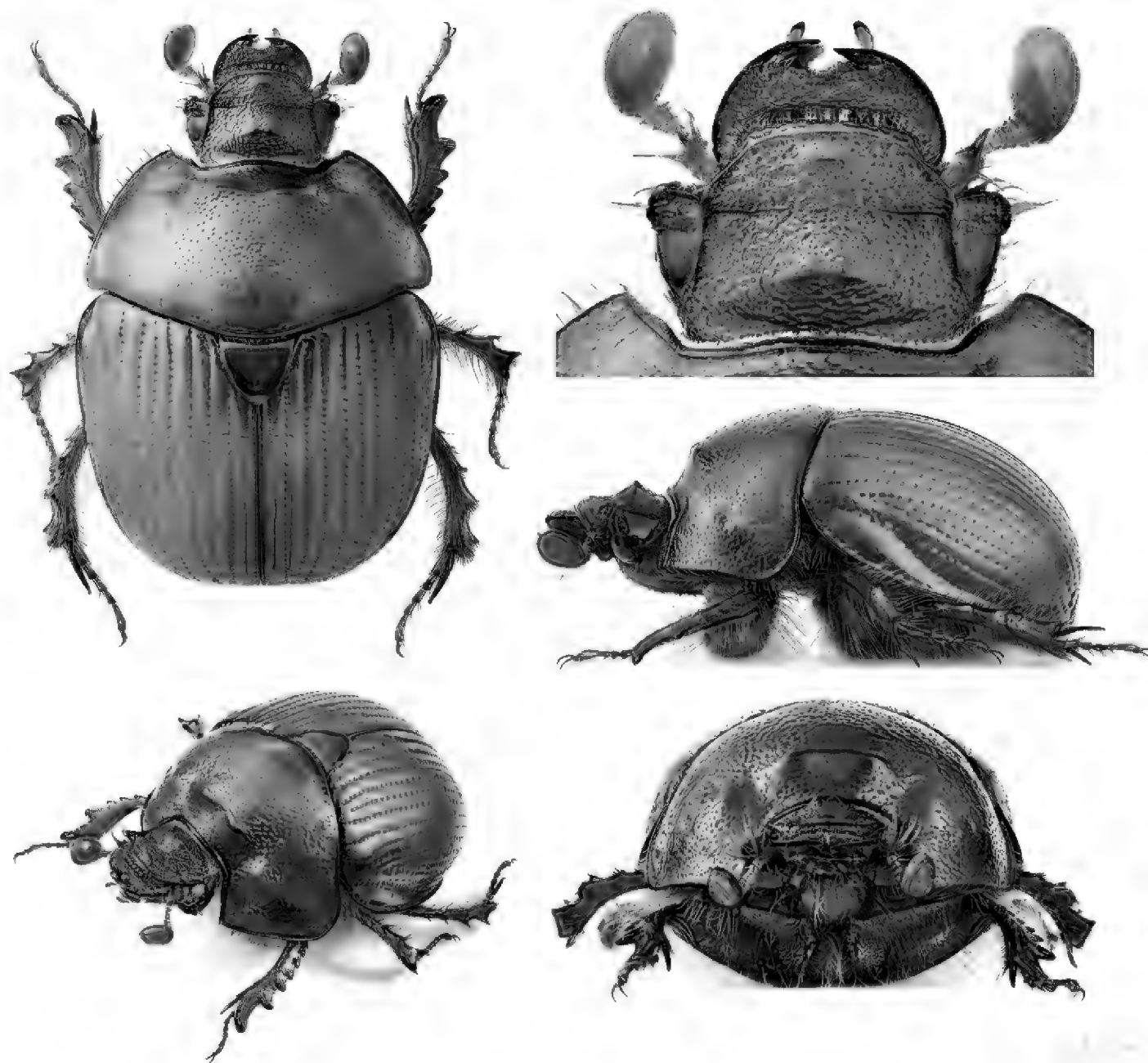


Figure 3. Small male of *B. unicornis* (body length: 11.5 mm) with feebly developed modifications of head and pronotum (Slovakia, Bratislava env.). The head features two small tubercles instead of the characteristic horn (photographs by Vlastimil Mihal).

other data [1 spec., anonymous collector leg. et coll.], non-public record of NDOP [= Records Database of Nature Conservation] of AOPK ČR [= Nature Conservation Agency of the Czech Republic].

6376: “Friedek Umg.” [= Frýdek-Místek env.], 20.vi.1923, 1 ♀ [ex. coll. Dr Karel Samšíňák], Jos[ef] Hlisnikowski [leg.], DJP det., coll. SMOC.

Comment

In the Czech Republic, the species is known from a few localities only. Old reports by Kral (1915) from Hradčany near Mimoň and by Hudeček (1928, 1930, 1937) from Přerov and Bochoř are dubious. In this study, the species is reported for the first time

from northern Moravia on the basis of an old record from the vicinity of Frýdek-Místek. The latest record from the Czech Republic is from Čejč from 2004 and will be published with additional details at a later date (David Král pers. comm., 2021). For the distribution of the species in the Czech Republic see Fig. 9.

Slovakia

Published data

7867: [Bratislava env.,] Děvín: Kobyla [= Devínska Kobyla hill], [between 1921–1936, see Kolečka 1995a], 1 spec. in horse dung, [František] Šlégl leg. (Roubal 1936; Majzlan et al. 2005); “Dévény” [= Bratislava – Devín], no other data (Endrődi 1957).

7568: Malacky, no other data (Roubal 1938).

7868: “Pozsony” or “Presburg” [= Bratislava] env., no other data (Bolla 1859; Rózsay 1868, 1880; Kuthy 1898; Ortvay 1902; Balthasar 1933; Roubal 1936; Endrődi 1957); Bratislava, June 1957, 1 ♂, collector unknown, coll. LKK (Juřena et al. 2008).

7968: Bratislava, Kopáč Island, [PR Kopáčsky ostrov], 19.v.2006, 1 spec., Malaise trap, MOB leg. (Majzlan 2006, 2007; Juřena et al. 2008).

7969: “Somorja” [= Šamorín], 10.v.1897, 1 spec. inside the digestive system of *Upupa epops*, Ernő Csiki obs. (Csiki 1905).

7371: “Pustá Ves” [= Prašník – Horná Pustá Ves or Dolná Pustá Ves], 22.vii.1984, 1 ♀, [at light], JMD leg., coll. NMPC (Hillert et al. 2016; data completed by the author).

7272: Čachtice, [probably between 1920–1938, see Kolečka 1981], F[rantišek] Hajný leg., coll. JDC (Juřena et al. 2008).

7572: Hlohovec, undated [probably first half of the 20th century], 1 ♀, Várkonyi leg., coll. DKP deposited in NMPC (Juřena et al. 2008; Hillert et al. 2016).

7373: Brunovce, no other data, 1 ♀ in coll. NMEG (Hillert et al. 2016).

7074: “Liborcsa” [= Nemšová – Ľuborča], [ca. 230 m a.s.l.], undated [probably second half of the 19th century], 2 spec., Nitnausz leg. (Brancsik 1899, 1905; Balthasar 1933); “Bolessó – Pjechó” [= Bolešov – Piechov], “Branne” forest, [ca. 250–300 m a.s.l.], undated, József Laczó leg. (Laczó 1905; Laco 1928); [Trenčín –] Zlatovce [env., Malá hora hill, 48°54'43"N, 18°0'30"E, ca. 230 m a.s.l. and Vinohrady, 48°54'47.22"N, 18°1'4.68"E, ca. 250 m a.s.l.], 1.vi.–10.vii.[probably 1920s], tens of spec., Rudolf Čepelák leg. (Čepelák 1925; the site specified from Čepelák's diary – see Fig. 20); June 1926, [Rudolf] Čepelák leg., 1 ♂ in coll. JSP (Juřena et al. 2008) and 1 ♀ (ex original coll. Vladimír Balthasar) in coll. NMPC (Hillert et al. 2016; data completed by the author); Trenčín – Zlatovce [env.], 27.vi.1935, 1 ♀, collector unknown, coll. NMPC (Hillert et al. 2016); Istebník env., “Weinberg” [= Trenčín – Zlatovce env., Vinohrady, 48°54'47.22"N, 18°1'4.68"E, ca. 250 m a.s.l.], May–July 1926–1927, more spec., Georg Polentz and Rudolf Čepelák leg. (Polentz 1927).

7174: Trenčín, date not specified, old vineyard, more spec, Rudolf Čepelák, František Hajný, and Ladislav Korbel leg., and 1 spec., Jan Roubal leg. (Roubal 1936); Trenčín, no other data (Endrődi 1957); “Trencsen, Hungaria” [= Hungary, Trenčín], 1 ♂ and 1 ♀ with no other data, coll. BMP (Bunalski 1999; collection specified by Bunalski pers. comm., 2021); Trencsen [= Trenčín], no other data, 1 ♂ and 1 ♀ in coll. OHS (Hillert et al. 2016); Trenčín, no other data, 3 spec. coll. TMLS (Kollár and Smetana 1994); Trenčín, [Rudolf] Čepelák leg., no other data (Tesař 1954, 1957); Trenčín, no other data, 2 ♂♂ and 1 ♀ in coll. NMPC (Hillert et al. 2016; data specified by the author), 1 ♀ with no other data (Král et al. 2018); Trenčín, undated, 1 ♀, V[ilém] Steidl leg., ex original coll. Jan Havelka, currently in coll. NMPC (Hillert et al. 2016; data specified by the author); Trenčín, undated, 1 ♂ and 1 ♀, Dr A[lois] Richter leg., coll. NMPC (Hillert et al. 2016); Trenčín, undated, [Rudolf] Čepelák leg., 2 ♂♂ and 3 ♀♀ in coll. DKP deposited in NMPC, 3 ♂♂ in coll. MJMC [data specified by the author], 1 spec. in coll. JMH, 2 ♀♀ in coll. JSP, 1 spec. in coll. MZP, 9 ♂♂ and 10 ♀♀ in coll. NMPC, 2 ♂♂ and 1 ♀ in coll. OHS, 1 spec. in coll. SDP (Juřena et al. 2008; Hillert et al. 2016; data specified by the author); Trenčín, undated, [Ladislav] Korbel leg., 3 ♂♂, in coll. MJMC (Juřena et al. 2008; data specified by the author); Trenčín, May 1931, Dr A[lois] Richter leg., 1 ♂ in coll. JMH (Juřena et al. 2008), 1 ♀ in coll. NMPC (Hillert et al. 2016); Trenčín, June 1931, 1 ♀, Dr A[lois] Richter leg., coll. MJMC (Juřena et al. 2008; data specified by the author); Trenčín, 1960, no other data, 1 ♀ in coll. MZB (Juřena et al. 2008).

7274: “Trenčín – Inovec” [= Považský Inovec Mts, Inovec hill env.], undated [probably 1920s–1930s], 1 ♂, [Rudolf] Čepelák leg., ex original coll. Rudolf Veselý, currently in coll. NMPC (Hillert et al. 2016; data completed by the author).

7374: “Podhragy” [= Podhradie near Topolčany], June and July 1895–1897, collector not specified (Kelecsényi 1900; Roubal 1936).

8174: “Keszegfalu” [= Keszegfalva, currently Kameničná], 25.v.1906, 1 spec. inside the digestive system of *Falco vespertinus*, Ernő Csiki obs. (Csiki 1910).

7275: Ľutov [env., Pálenice hill, ca. 48°46'57"N, 18°16'44"E, 250–300 m a.s.l.], 1.vi.–15.vii.[probably 1920s], Čepelák leg. (Tesař 1957; the site specified from Čepelák's diary – see Fig. 20).

8176: “Bátorkeszi” [= Bátorove Kosihy], June [between 1919–1923, see Kolečka 1995b], 1 spec., sandy path, [Václav] Thurnher leg. (Roubal 1936; Endrődi 1957).

8177: Štúrovo (8278) [Štúrovo env., Belianské kopce hills, Modrý vrch hill env., PR Vršok env.], 24.v.1985, 2 spec., RFO (Týr 1997); Modrý vrch hill near Štúrovo [= Štúrovo env., Belianské kopce hills, Modrý vrch hill env., PR Vršok env.], 28.vi.1981, 1 ♂ and 1 ♀, 23.v.1985, 1 ♂, IJN (Juřena et al. 2008).

8178: Kamenica nad Hronom env., 47°50'29.5"N, 18°43'34.8"E, 9.vii.1980, ca. 30 spec. FSLG around midnight, PJH leg., 1 ♂ and 1 ♀ in coll. VJP, 1 ♀ in coll. ZDP deposited in ZMPC (Juřena et al. 2008; data supplemented by VJP pers. comm., 2021, and the author); 17.vii.1990, 1 ♂ and 1 ♀, 5.v.1992, 1 ♂, MTS (Juřena et al. 2008); 26.vi.1999, 1 ♂ and 1 ♀, dead on a path, JCM (Juřena et al. 2008); 24.v.2008,

2 ♀♀, at light (flew through the open window) ca. at 21.45 CEST, BBO (Juřena et al. 2008); Kamenica nad Hronom env., NPR Burdov, 47°49'32.88"N, 18°44'54.72"E, 154 m a.s.l., June 2011, 1 spec., Malaise trap, Vladimír Hošek leg. (Majzlan 2016); Kováčov, July 1985, 1 spec., ZVP (Týr 1997), 5.vii.1985, 1 spec., KPV leg., coll. JRS (Juřena et al. 2008); 4.vii.1999, 1 ♂, Karel Deneš Sr. leg., coll. DCO (Juřena et al. 2008); 29.vi.2001, 1 ♂, at light, JSU leg., coll. MSZ (Juřena et al. 2008).

8179: Chĺaba env., 47°49'27"N, 18°50'57"E (the site near the confluence of the Danube and Ipel' rivers), 103 m a.s.l., 5.vii.1975, plant materials alluviated by flooded Danube and Ipel' rivers, 1 ♀, VKS leg. et coll., 1 ♂, PPB leg., coll. VKS (Juřena et al. 2008; data corrected by VKS pers. comm., 2021).

7781: "Plachti[n]ce" [= Horné, Stredné or Dolné Plachtince], 5.vi.1938, [Rudolf] Schwarz leg. (Tesař 1957).

7683: "Losoncz" [= Lučenec], 1877–1891, Emil Malesevics leg. (Malesevics 1892; Černecký et al. 2014); Lučenec, June [probably first half of the 20th century], Slanec leg. (Roubal 1936).

7884: Šiatorská Bukovinka, parking at the cemetery, [48°11'4"N, 19°49'33"E; 290 m a.s.l.], 8.vii.1973, 1 spec., at light (kerosene lamp), SKP leg., coll. SPP (Skýpala 1978; Juřena et al. 2008; storage of the specimen specified by Serge Peslier pers. comm., 2022)

7785: Hajnáčka [– Buková, 48°13'36.97"N, 19°58'24.11"E, steppe slope near the forest], 15.vii.1984, 1 ♀, dead on the ground, RCP (Juřena et al. 2008); 5.–8.vi.1986, 1 ♂, JMH; 18.v.1989, 1 ♂ FSLG after sunset, IMO; 5.vi.1989, 1 ♀, in flight at 21.35 CEST, IMO; 10.–11.vi.1989, 7 ♂♂ and 2 ♀♀, in flight after sunset or crawling on the ground, RVO (Juřena et al. 2008); 11.vi.1989, 1 ♂ and 2 ♀♀ FSLG after sunset, APO (Juřena et al. 2008); 24.vi.1989, 3 ♂♂ and 2 ♀♀ FSLG after sunset, MBO (Juřena et al. 2008); 27.vi.1989, 1 ♂ and 1 ♀ FSLG after sunset, RVO (Juřena et al. 2008); 1.vii.1989, 1 ♂ and 1 ♀ excavated with a garden shovel from their burrow on a steppe in the immediate vicinity of an oak forest (the burrow with push-up was localised thanks to audible stridulation of one or both specimens), VMP (Juřena et al. 2008); 6.vii.1989, 1 ♂ and 2 ♀♀ FSLG after sunset, MBO (Juřena et al. (2008); 16.vi.1990, 1 ♀ FSLG at 21.25 CEST, VJP (Juřena et al. 2008); 17.vi.1990, 1 ♂ flying at 21.28 CEST, VJP, 2 ♀♀ flying at 21.30–22.00 CEST, MNR (Juřena et al. 2008); 28.vi.1990, 1 ♂ crawling on the ground near an oak forest at 21.30 CEST, IMO (Juřena et al. 2008); 16.vi.1991, 1 ♂ and 1 ♀ FSLG at 21.25 CEST, VJP; 16.vi.1992, 3 ♂♂ and 3 ♀♀ FSLG after sunset, JDC, VJP (Juřena et al. 2008); 18.vi.1992, 1 ♂ and 1 ♀ FSLG after sunset, JDC (Juřena et al. 2008); 16.vi.1994, 2 ♂♂ FSLG after sunset, APO (Juřena et al. 2008); 28.v.1995, 1 spec., JKP (Týr 1997), 1 ♀ flying at 21.30–22.00 CEST, MNR (Juřena et al. 2008); 3.vii.1997, 3 ♀♀ FSLG at 21.30–22.00 CEST, MZP, MNR (Juřena et al. 2008); 16.vi.2009, together with *Od. armiger* and *Och. chrysomeloides*, the number of spec. and the collector name not specified (Byk et al. 2012).

7882: Kiarov, 15.–20.vi.1936, 1 ♀, [Dr Rudolf] Schwarz leg., ex original coll. Bohumil Štícha, currently in coll. NMPC (Juřena et al. 2008; Hillert et al. 2016; data completed by the author).

7277: Prievidza, forest park, 18.vii.1995, 1 ♂, RGM; (Juřena et al. 2008).

7280: Banská Bystrica, 18.v.1979, 1 ♂, collector unknown, coll. KVS (Juřena et al. 2008; Hillert et al. 2016).

7488: Silická Brezová, 3.vi.1999, 1 ♀, dead on a path crossing a steppe meadow, KDO (Juřena et al. 2008).

7390: Hrhov, 20.–21.vii.1981, 10 spec. excavated from their burrows, in a few cases together with *Od. armiger* (at a depth of up to 7 cm, the burrows changed direction from vertical to horizontal; in two cases, in one hole were two males or two females of *B. unicornis* together), LMT (Juřena et al. 2008).

7494: Slanská Huta env., 48°34'54.8"N, 21°28'31.7"E, 600 m a.s.l., 24.vii.1972, 1 ♀ crawling on the ground after sunset, ZLB obs. + photo – see Fig. 14A (Juřena et al. 2008; data specified by ZLB pers. comm., 2022).

7596: Ladmovce, 9.viii.1982, 2 ♂♂ excavated from their burrows from a depth of 8 cm, and 1 ♀ from a depth of ca. 20 cm, LMT (Juřena et al. 2008).

7097: Lackovce env., Veľká hill, [ca. 48°56'35"N, 21°58'13.5"E], 2.vii.–31.viii.2001, 2 ♂♂ and 2 ♀♀, steep forest-steppe hillside with shrubbery of *Rosa canina* and *Prunus spinosa*, pitfall traps with formaldehyde, together with more spec. of *Od. armiger*, VTH leg., coll. VMHS (Juřena et al. 2008); 16.vii.2017, 1 spec., pitfall trap with formaldehyde (48°56'37.63"N, 21°58'14.33"E), A. Macková leg. (Gajdoš and Majzlan 2018; Majzlan 2018).

7098–7099: Snina, July 1965, 1 ♂, MPP leg., coll. DKP deposited in NMPC (Hillert et al. 2016).

Material examined and new observations

7868: “Pressburg” [= Bratislava], no other data, 2 ♂♂ and 3 ♀♀ in coll. UMJG; “Hu, Pressburg” [= Hungaria, Bratislava], undated, 1 ♂, Maj[or Robert] Weber [leg.], coll. UMJG.

7868–7869: Bratislava – Podunajské Biskupice, Kopáč Island, PP Panský diel env. (Figs 4, 5), (e.g., 48°6'4.83"N, 17°9'37.55"E; 48°6'5.7"N, 17°9'48.7"E; 48°6'6.58"N, 17°9'58.21"E; 48°6'6.77"N, 17°10'2.16"E), 132–133 m a.s.l., 31.vii.2009, 1 ♀, at UV light, KBB leg., coll. DVH; 18.viii.2014, 1 ♀, at light, KBB obs.; 20.viii.2014, 1 ♂ and 1 ♀ FSLG after sunset, AHB and RHB obs.; 27.viii.2014, 2 ♀♀ FSLG after sunset, AHB obs.; 5.ix.2014, 3 ♂♂ and 2 ♀♀ FSLG after sunset, PKG and RHB obs.; 3.vi.2015, 11 ♂♂ and 4 ♀♀ flying slowly 10–20 cm above the ground after sunset, AHB and RHB obs.; 5.vi.2015, 5 ♂♂ and 1 ♀ flying slowly 10–20 cm above the ground after sunset, PKG and RHB obs.; 7.vi.2015, 4 ♂♂ FSLG after sunset, AHB obs.; 26.viii.2015, 2 ♀♀ flying slowly ca. 0.5 m above the ground at 20.20 and 20.30 CEST, DJP obs.; 28.viii.2015, 1 ♀ flying ca. 10–20 cm above the ground at 20.27 CEST, AHB obs.; 29.v.2016, 7 spec. FSLG after sunset, together with ca. 15 spec. of

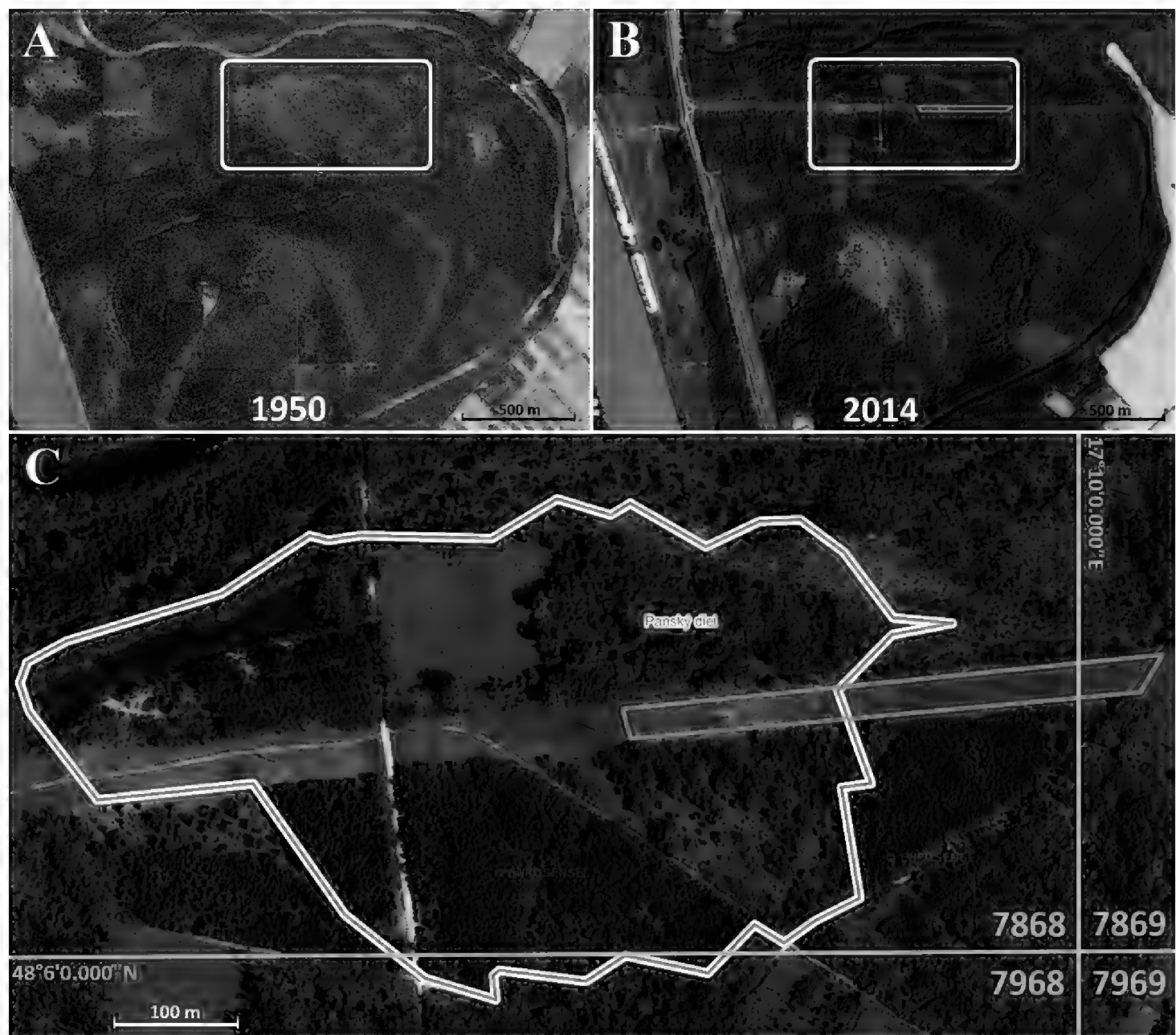


Figure 4. Bratislava, Kopáč Island (Slovakia), the area with the largest known population of *B. unicornis* in Europe before its conversion by inappropriate conservation management (removal of small trees and shrubs and introduction of intensive sheep grazing) **A** view of the site in 1950 **B** view of the site in 2014 with the area of the highest density of *B. unicornis* outlined with yellow borders **C** detail of the area with the highest density of the species with faunistic squares marked (see Materials and methods and Fig. 9).

Od. armiger, EJB, MSB and RHB obs.; 7.vi.2016, 11 spec. (4 ♂♂, 6 ♀♀ and 1 spec. not sexed) FSLG at 21.25–21.45 CEST, AHB and RHB obs. (see Table 1 for full data on the flights); 8.vi.2016, 5 spec. (4 ♂♂ and 1 spec. not sexed) flying slowly ca. 0.5 m above the ground at 21.27–21.43 CEST, together with 3 spec. of *Od. armiger*, DJP obs. (see Table 1 for full data on the flights); 18.vi.2016, 3 ♂♂ and 3 ♀♀ flying relatively slowly (but faster than 8.vi.2016) ca. 0.5 m above the ground at 21.33–21.53 CEST, DJP obs. (see Table 1 for full data on the flights); 21.vi.2016, 3 ♂♂ and 2 ♀♀ flying slowly ca. 0.5 m above the ground at 21.31–22.03 CEST, MSB obs. (see Table 1 for full data on the flights); 22.vi.2016, 2 ♂♂ and 4 ♀♀ flying slowly ca. 0.5 m above the ground at 21.21–21.57 CEST, MSB obs. (see Table 1 for full data on the flights); 23.vi.2016, 3 ♂♂ and 1 ♀ excavated from their burrows on the edge of a path crossing a forest-steppe meadow, 6 ♂♂ and 5 ♀♀ FSLG at 21.33–21.53 CEST, together



Figure 5. Bratislava, Kopáč Island, PP Panský diel (Slovakia) in 2016 (before its conversion due to inappropriate conservation management) **A–D** site details (**A** photographed by Dalibor Všíanský **B–D** photographed by Ilja Trojan) **E** push-up of *B. unicornis* (photograph by Milan Štrba) **F** male excavated from its burrow (photograph by Dalibor Všíanský).

with ca. 15 spec. of *Od. armiger*, DJP obs. (see Table 1 for full data on the flights); 24.vi.2016, 10 ♂♂ and 14 ♀♀ FSLG at 21.36–22.08 CEST, DJP, MSB and PKG obs. (see Table 1 for full data on the flights); 25.vi.2016, 2 ♂♂ and 5 ♀♀ FSLG at 21.28–22.08 CEST, MSB and FSB obs. (see Table 1 for full data on the flights); 26.vi.2016, 13 ♂♂ and 12 ♀♀ flying slowly up to ca. 0.5 m above the ground or relatively quickly ca. 1.5 m above ground at 21.31–22.09 CEST, together with ca. 10 spec. of *Od. armiger* and 3 spec. of *Ochodaeus chrysomeloides* (Schrank, 1781), DJP, FSB, MSB and PKG obs. (see Table 1 for full data on the flights); 27.vi.2016, 2 ♂♂ and 8 ♀♀ FSLG at 21.31–22.57 CEST, MSB and FSB obs. (see Table 1 for full data on the flights);

28.vi.2016, 2 ♂♂ and 7 ♀♀ flying slowly up to ca. 0.5 m above the ground or relatively quickly ca. 1–1.5 m above the ground at 21.28–22.48 CEST, together with 1 spec. of *Od. armiger*, DJP and PKG obs. (see Table 1 for full data on the flights); 29.vi.2016, 8 ♂♂ and 6 ♀♀ FSLG at 21.29–22.03 CEST, together with ca. 10 spec. of *Od. armiger* and 7 spec. of *Och. chrysomeloides*, DJP, PKG and MSB obs. (see Table 1 for full data on the flights); 30.vi.2016, 2 ♂♂ and 3 ♀♀ FSLG at 21.38–22.48 CEST, MSB and FSB obs.; 1.vii.2016, 1 ♀ flying slowly up to 0.5 m above the ground at 21.35 CEST, together with 1 spec. of *Od. armiger* and 1 spec. of *Och. chrysomeloides*, DJP obs.; 21.vii.2016, 25 ♂♂ and 11 ♀♀, most individuals flying slowly, some relatively quickly, up to 0.5 m above the ground, 2 spec. flying quickly ca. 1–1.5 m above the ground, at 21.09–21.51 CEST, together with more spec. of *Od. armiger* and *Och. chrysomeloides*, DJP and MSB obs. (see Table 1 for full data on the flights); 22.vii.2016, 28 ♂♂ and 23 ♀♀ flying up to 0.5 m above the ground at 21.08–21.51 CEST, together with more spec. of *Od. armiger* and *Och. chrysomeloides*, DJP and MSB obs. (see Table 1 for full data on the flights); 23.vii.2016, 26 ♂♂ and 15 ♀♀ flying up to 1 m above the ground at 21.09–21.53 CEST, together with more spec. of *Od. armiger* and *Och. chrysomeloides*, DJP and MSB obs. (see Table 1 for full data on the flights); 24.vii.2016, 38 ♂♂ and 30 ♀♀ flying mostly up to 0.5 m above the ground at 21.08–21.49 CEST, together with more spec. of *Od. armiger*, DJP, DVB, FSB and MSB obs. (see Table 1 for full data on the flights); 25.vii.2016, 14 ♂♂ and 1 ♀ FSLG at 21.06–21.41 CEST, 22 °C, light rain, no wind, FSB and MSB obs. (see Table 1 for full data on the flights); 26.vii.2016, 2 ♂♂ FSLG at 21.08–21.10 CEST, 24 °C, dry, gentle persistent wind, MSB obs.; 29.vii.2016, 6 ♂♂ and 2 ♀♀ excavated from their burrows on a loess-sandy path crossing a steppe meadow, together with 1 spec. of *Od. armiger* and 3 spec. of *Och. chrysomeloides*, DJP obs., and 10 ♂♂ and 3 ♀♀ FSLG at 21.02–21.30 CEST, 22 °C, wet vegetation, no wind, MSB obs. (see Table 1 for full data on the flights); 30.vii.2016, 1 ♂ excavated from its burrow on a loess-sandy path crossing a steppe meadow, DJP obs., and 16 ♂♂ and 21 ♀♀ FSLG at 20.53–21.56 CEST, together with ca. 20 spec. of *Od. armiger* and ca. 10 spec. of *Och. chrysomeloides*, DJP and MSB obs. (see Table 1 for full data on the flights); 7.viii.2016, 1 ♂ and 1 ♀ excavated from its burrow on a loess-sandy path crossing a steppe meadow, DJP obs., and 16 ♂♂ and 13 ♀♀ FSLG at 20.46–21.16 CEST, together with ca. 10 spec. of *Od. armiger*, 17 °C, no wind, DJP and IMO obs. (see Table 1 for full data on the flights); 8.viii.2016, 26 ♂♂ and 20 ♀♀ FSLG at 20.45–21.25 CEST, together with ca. 15 spec. of *Od. armiger* and 2 spec. of *Och. chrysomeloides*, 17–14 °C, no wind, DJP, ITV, FTV, IMO and JKO obs. (see Table 1 for full data on the flights); 13.viii.2016, 32 ♂♂ and 19 ♀♀ flying slowly up to 0.5 m above the ground at 20.40–21.01 CEST, together with ca. 30 spec. of *Od. armiger* and 7 spec. of *Och. chrysomeloides*, 19 °C, no wind, DJP, ITV and FTV obs. (see Table 1 for full data on the flights); 14.viii.2016, 2 ♂♂ and 3 ♀♀ FSLG after sunset, together with 4 spec. of *Od. armiger*, 20 °C, no wind, MSB and VKS obs.; 4.vii.2020, 1 ♂ excavated from its burrow on the edge of a path, DJP obs., 6 spec. FSLG after sunset, together with 1 spec. of *Od. armiger* and 8 spec. of *Och. chrysomeloides* DJP and FSP obs.; 6.viii.2020, 6 spec. FSLG at 21.05–21.15 CEST, FSP, IMO, PMB and VZO obs.

7968: Rusovce – Záhrady, 48°3'20.614"N, 17°9'18.014"E, 140 m a.s.l., 6.vi.2020, 1 ♂ flying ca. 10–20 cm above the ground at 21.20 CEST, small forest-steppe clearing in the forest, SRB obs. + photo (DJP det.); Bratislava – Podunajské Biskupice, Kopáč Island, PR Kopáčsky ostrov, ca. 48°5'41.97"N, 17°9'43.14"E, 132 m a.s.l., 13.vi.2006, 1 ♀, Malaise trap, MOB leg., coll. VKS; 30.v.2016, 2 ♂♂, and 3 ♀♀ FSLG after sunset, together with ca. 15 spec. of *Od. armiger*, EJB and RHB obs.; 7.vi.2016, 1 spec. FSLG after sunset, MSB obs.; 23.vi.2016, 2 ♂♂ FSLG at 21.32 and 21.38 CEST, MSB obs.; 1.vii.2016, 2 ♂♂ FSLG at 21.27 and 21.43 CEST, MSB obs.; 19.vii.2016, 4 spec. FSLG after sunset, EJB and JKB obs.; 20.vii.2016, 7 spec. FSLG after sunset, EJB and JKB obs.; ca. 48°5'39.5"N, 17°9'42.3"E, and 48°5'43.8"N, 17°9'30.4"E, 14.viii.2016, 7 spec. FSLG after sunset, DJP, ITV and VKB obs.; ca. 48°5'45.8"N, 17°9'41.9"E, 19.v.2018, 1 ♂ and 1 ♀ FSLG after sunset, MRV and VMP obs.; 9.vi.2018, 7 ♂♂ and 9 ♀♀ FSLG after sunset, together with ca. 20 spec. of *Od. armiger*, JHP, MRV and VMP obs.; 14.vii.2018, 1 ♂ and 4 ♀♀ FSLG after sunset, JRC and MRV obs.

7869–7969: “Štefánikovce” [= Rovinka near Dunajská Lužná], ca. 130 m a.s.l., May 1949, tens of spec. observed during the day sitting on the tops of the grass blades above the water on a flooded steppe meadow (after the flood), Josef Marvan obs., 2 spec. (♂ and ♀) leg., coll. IMP.

7969: Bratislava – Čunovo, PR Ostrovné lúčky (Fig. 6C, D), 48°2'28.02"N, 17°10'33.41"E, 138–139 m a.s.l., 21.vi.2016, 2 ♀♀ FSLG at 21.42 and 21.45 CEST, AHB obs.; ca. 48°2'24.5"N, 17°10'30.14"E and ca. 48°2'23.77"N, 17°10'34.47"E, 25.vii.2016, 6 ♂♂ and 4 ♀♀ flying slowly up to 0.5 m above the ground at 21.10–21.37 CEST, together with 7 spec. of *Od. armiger* and 3 spec. of *Och. chrysomeloides*, DJP obs. (see Table 2 for full data on the flights); 29.vii.2016, 1 ♂ and 1 ♀ flying quickly and 1 ♂ flying slowly up to 0.5 m above the ground at 21.11–21.25 CEST, together with 1 spec. of *Od. armiger* and 2 spec. of *Och. chrysomeloides*, DJP obs. (see Table 2 for full data on the flights); Kalinkovo env., Kalinkovská lesostep (Fig. 6A, B), 48°3'39.82"N, 17°12'37.94"E, 130 m a.s.l., 22.vi.2016, numerous ca. 2–3 weeks old burrows with push-ups weathered down, DJP and AHB obs.; 27.vii.2016, 1 ♂ and 2 ♀♀ flying up to 1 m above the ground at 21.04–21.15 CEST, together with 1 spec. of *Od. armiger*, DJP obs. (see Table 3 for full data on the flights).

7272: Višňové, Čachtický hradný vrch hill, 22.v.1988, 1 ♂ dead on a forest-steppe slope, IPO leg., coll. DJP.

7572: Hlohovec env., Nová hora near Koplotovce, 48°28'24.98"N, 17°49'21.40"E, 260 m a.s.l., 12.iv.1988, 1 ♀, accidentally dug up while turning the soil in the garden, KPH leg., coll. VKS; Hlohovec env., Mlynárska hora near Koplotovce, 48°28'6.51"N, 17°49'29.04"E, 235 m a.s.l., 4.vi.2021, 1 ♀ at light at 21.10 CEST (= 27 minutes after sunset), TSH obs.

7772: Šoporňa, [ca. 122 m a.s.l.], July 1952, 1 ♂, Kotek leg., coll. MHKC.

7373: Modrovka, [ca. 170 m a.s.l.], 15.vii.1979, 1 ♀, Mrklovský leg., coll. Ladislav Bojčuk deposited in MHKC.

7074: Trenčín – Zlatovce [env.], June 1926, [Rudolf] Čepelák leg., 1 ♂ and 1 ♀ in coll. Josef Gottwald deposited in NHMB, 2 ♀♀ in coll. Paolo Luigioni deposited

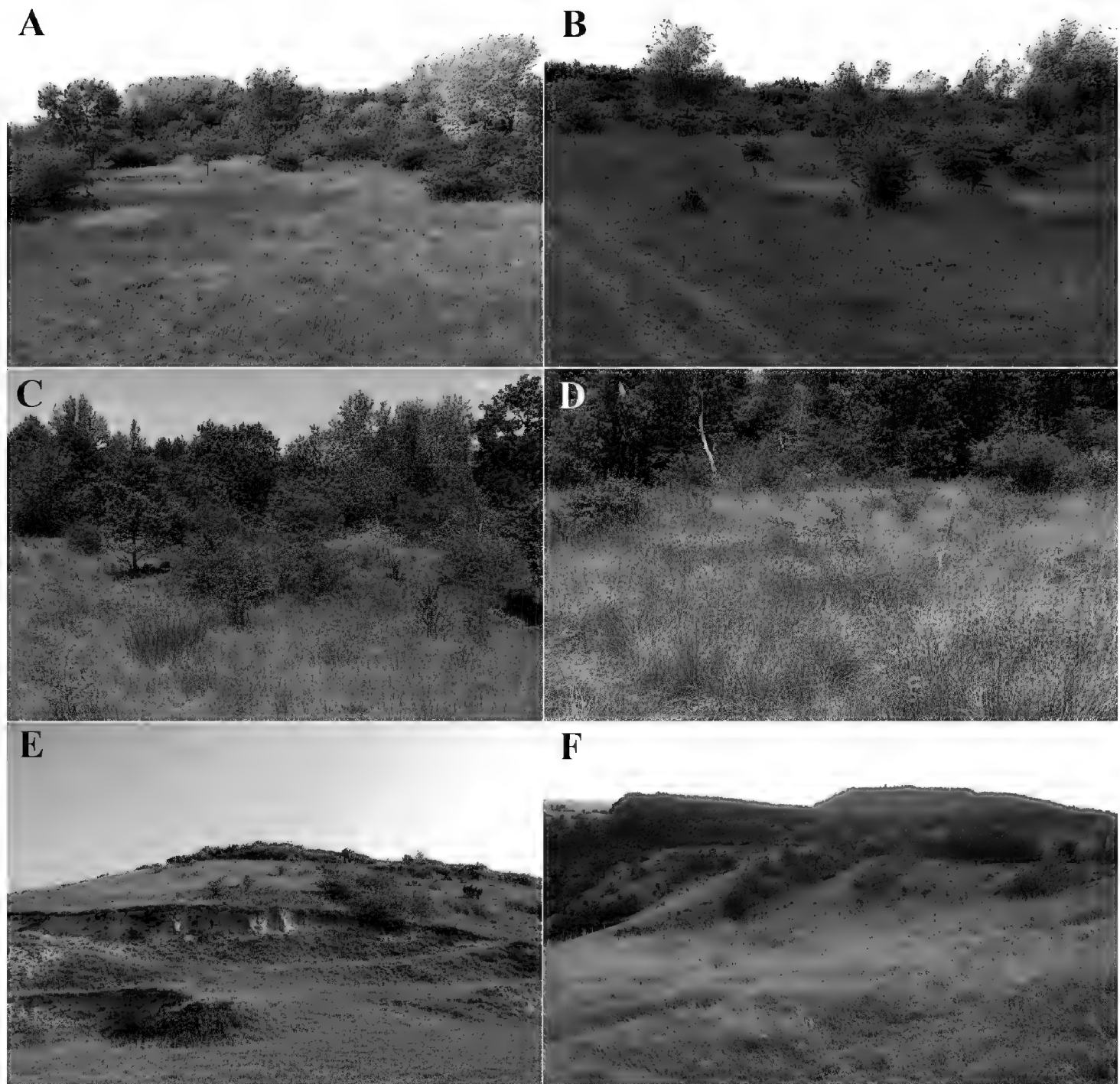


Figure 6. Slovak localities with *B. unicornis* **A, B** Kalinkovo, Kalinkovská lesostep **C, D** Čunovo, PR Ostravné lúčky (photographs by Milan Štrba) **E** Gemerský Jablonec (photograph by Ilja Trojan) **F** Hajnáčka (photograph by Ilja Trojan).

in MCZR, 1 ♂ in coll. Zdeněk Tesař deposited in SNMS, 1 ♂ in coll. MIZP; Trenčín – Zlatovce [env.], June 1926, 1 ♀, collector not specified, coll. TLMF; [Trenčín –] Zlatovce [env.], no other data, 2 ♀♀ in coll. Zdeněk Tesař deposited in SNMS; June 1931, L[adislav] Korbel leg., 1 ♂ in coll. JJP, 1 ♀ in coll. Ladislav Daněk deposited in MHKC; June 1935, 1 ♂ and 1 ♀ (ex coll. Johann Peter Wolf), “col. Kardasch” [= Gregor Kardasch leg.], coll. ETHZ.

7174: “Trencsen Ungarn” [= Hungary, Trenčín], undated, 1 ♂ and 1 ♀ (ex coll. Engelbert Pawlik) in coll. NMPC, 1 ♂ and 1 ♀ in coll. FMNH, 2 spec. in coll. ZSMG, 1 spec. in coll. MTDG, 2 ♀♀ (ex coll. P. Franck) in coll. MIZP, 1 ♀ (ex coll. † Richard Papperitz, Peutenhausen) in coll. SMNS; Trenčín, no other data, 3 spec. in coll. NHMW, 1 ♂ in coll. MNBG, 1 spec in coll. SZM; “Trencin Slow.” [= Slovakia,

Trenčín], no other data, 1 ♀ in coll. Leopold Mader deposited in MNSA; “Trenčín, Tchécoslovaquie” [= Slovakia, Trenčín], undated, 1 ♂ and 1 ♀, “coll. J[oseph] Clermont”, coll. Jacques Baraud deposited in MNHN; “Slovakia Trenčín”, 2.vii.[year not specified], no other data, 1 ♀ in coll. MHKC; Trenčín, undated, [Rudolf] Čepelák [leg.], 6 ♂♂ and 5 ♀♀ in coll. Leopold Mader deposited in MNSA, 5 ♂♂ and 4 ♀♀ in coll. SNMS, 3 ♂♂ and 5 ♀♀ in coll. MHNG, 2 ♂♂ and 3 ♀♀ in coll. MNBG, 3 ♂♂ and 1 ♀ (ex coll. W. Liebmann, Arnstadt) in coll. SDEI, 2 ♂♂ and 2 ♀♀ in coll. Henri Coiffait deposited in MNHN, 3 ♂♂ and 1 ♀ (ex coll. Johann Peter Wolf) in coll. ETHZ, 3 ♂♂ and 1 ♀ in coll. MHKC, 2 ♂♂ (ex coll. Sten Stockmann) in coll. FMNH, 1 ♂ and 1 ♀ in coll. MIZP, 1 ♂ and 1 ♀ in coll. SMNS, 1 ♂ in coll. RBIN, 1 ♂ in coll. Ladislav Daněk deposited in MHKC, 1 ♀ in coll. Jacques Baraud deposited in MNHN, 1 ♂ in coll. Georg Frey deposited in NHMB, 1 ♂ and 1 ♀ in coll. Vladimír Zoufal deposited in MMBC, 1 ♀ in coll. Emil Jagemann deposited in MMBC, 2 spec. in coll. ZSMG, 1 ♂ (ex coll. Antonio Porta) in coll. MSNM, 1 spec. (head and pronotum missing) in coll. RMNH, 2 ♂♂ in coll. LEN, 1 ♂ in coll. DKC, 1 ♀ in coll. VKS; Trenčín, undated [most likely late 1920s/early 1930s], Z. Zeman leg., 1 ♀ in coll. SMNS, 1 ♂ in coll. VKS; Trenčín, undated, 1 ♂, V[ilém] Steidl [leg.], coll. MIZP; Trenčín, undated, [Ladislav] Krejčárek [leg.], 2 ♂♂ and 1 ♀ in coll. TMLS (see Kollár and Smetana 1994), 1 ♀ in coll. VKS; June 1925, 1 ♂, [Rudolf] Čepelák [leg.], coll. Jan Roubal deposited in SNMS; Trenčín, 16.vi.1928, 1 ♀, [Rudolf] Čepelák leg., coll. Jan Roubal deposited in SNMS; Trenčín, 18.vi.1929, [Ladislav] Korbel [leg.], 1 ♂ and 1 ♀ (ex coll. Dr J. B. Jörger, Masans bei Chur) in coll. NHMB, 1 ♂ in coll. FMNH; Trenčín, 1931, 3 ♂♂ and 3 ♀♀, [Rudolf] Čepelák [leg.], coll. Paolo Luigioni deposited in MCZR; Trenčín, May 1931, Dr A[lois] Richter leg., 1 ♀ in coll. NMPC, 1 ♀ in coll. MJMC; “Trencsin” [= Trenčín], undated, 1 spec., S. Kardasch [leg.], coll. SMNK; Trenčín, June 1935, 1 spec., G[regor] Kardasch [leg.], coll. SMNK; Trenčín, 1936, 2 spec., [Rudolf] Čepelák [leg.], coll. SMNK; Trenčín, June 1936, 1 ♂ and 1 ♀, [Rudolf] Čepelák [leg.], coll. VKS; Trenčín, July [19]36, 1 ♂ in coll. Jan Volák deposited in MHKC.

7274: [Považský Inovec Mts], Inovec [hill env.], 1 ♂, [Ladislav] Krejčárek [leg.], coll. Josef Gottwald deposited in NHMB.

7674: Nitra [env.], 1950, no other data, 1 ♂ in coll. MHKC.

8177: Štúrovo env., Belianské kopce hills, “Hegyfarok” [= Modrý vrch], 47°49'8.09"N, 18°39'32.4, ca. 150 m a.s.l., 20.viii.2005, 1 spec., at light after midnight, 1.ix.2005, 1 spec., at light after midnight, 14.vi.2006, 2 spec., at light, 15.vi.2006, 1 spec., at light, 15.vi.2007, 1 spec., at light, 29.vii.2008, 2 spec., at light, 30.vii.2008, 1 spec., VVO obs.; Modrý vrch, PR Vršok, 47°49'6"N, 18°39'33"E, ca. 150 m a.s.l., 22.v.2014, 1 ♂, at light, OSO obs.; 47°49'13.5"N, 18°39'21.5"E, ca. 195 m a.s.l., 4.vi.2015, 1 ♀ at UV light at 21.30–0.30 CEST and 1 ♀ at UV light (the same trap) at 1.15 CEST (5.vi.2015), OSO obs. (moreover ca. 50 spec. of *Och. integriceps* Semenov, 1891 in the light traps were observed); 6.vi.2015, 1 ♂ FSLG after sunset, anonymous observer from the Czech Republic obs. (moreover 1 spec. of *Och. integriceps* in the light trap was observed); 47°49'9.54"N, 18°39'26.4"E, ca.



Figure 7. Biotopes of *B. unicornis* near Kamenica nad Hronom (Slovakia) **A–C** Čierna hora hill (**A, B** photographed by Ilja Trojan) **D** southwest facing slope northeast of Čierna Hora hill with old vineyards (photograph by Ondřej Sabol).

170 m a.s.l., 27.v.2015, 1 spec. FSLG after sunset, and 1 spec. at light, two anonymous observers from the Czech Republic obs.

8078: Zalaba, 47°58'8.8"N, 18°42'29.2"E, ca. 150 m a.s.l., June 1975, 1 spec. crawling on the ground on a sandy slope sparsely covered with black locust trees (*Robinia pseudoacacia*) at ca. 19.00 CEST, JAH.

8178: Bajtava, 16.vi.2006, 1 spec., at light, VVO obs.; Kamenica nad Hronom, Čierna hora hill (Fig. 7A–C), ca. 47°50'15"N, 18°43'34"E, ca. 180–190 m a.s.l., 27.vi.2009, 1 ♂ FSLG at 21.36 CEST, together with 1 ♂ a 2 ♀♀ of *Od. armiger*, OSO obs.; 5.vi.2010, 1 ♀ FSLG at 21.35 CEST, PJJ obs.; 6.vi.2010, 3 ♂♂ and 1 ♀ FSLG at 21:30–21:45 CEST, and 1 ♂ at light, JHL, OSO and RSP obs. (see Table 4 for full data on the flights); 7.vi.2010, 16 spec. FSLG at 21:23–21:55 CEST, JHL, PJJ, OSO and RSP obs. (see Table 4 for full data on the flights); 11.vi.2010, 4 ♂♂ flying relatively quickly ca. 1 m above the ground after sunset, light breeze to gentle breeze, DJP obs.; 12.vi.2010, 1 ♂ and 1 ♀ FSLG after sunset, light air to light breeze, DJP obs.; 26.vi.2010, 3 ♂♂ FSLG after sunset, LKK and PJJ obs.; 27.vi.2010, 6 ♂♂ and 4 ♀♀ FSLG after sunset, LKK, PJJ and OSO obs.; 30.vi.2010, 7 spec. FSLG after sunset, two anonymous observers from the Czech Republic obs.; 4.viii.2011, 17 spec. flying

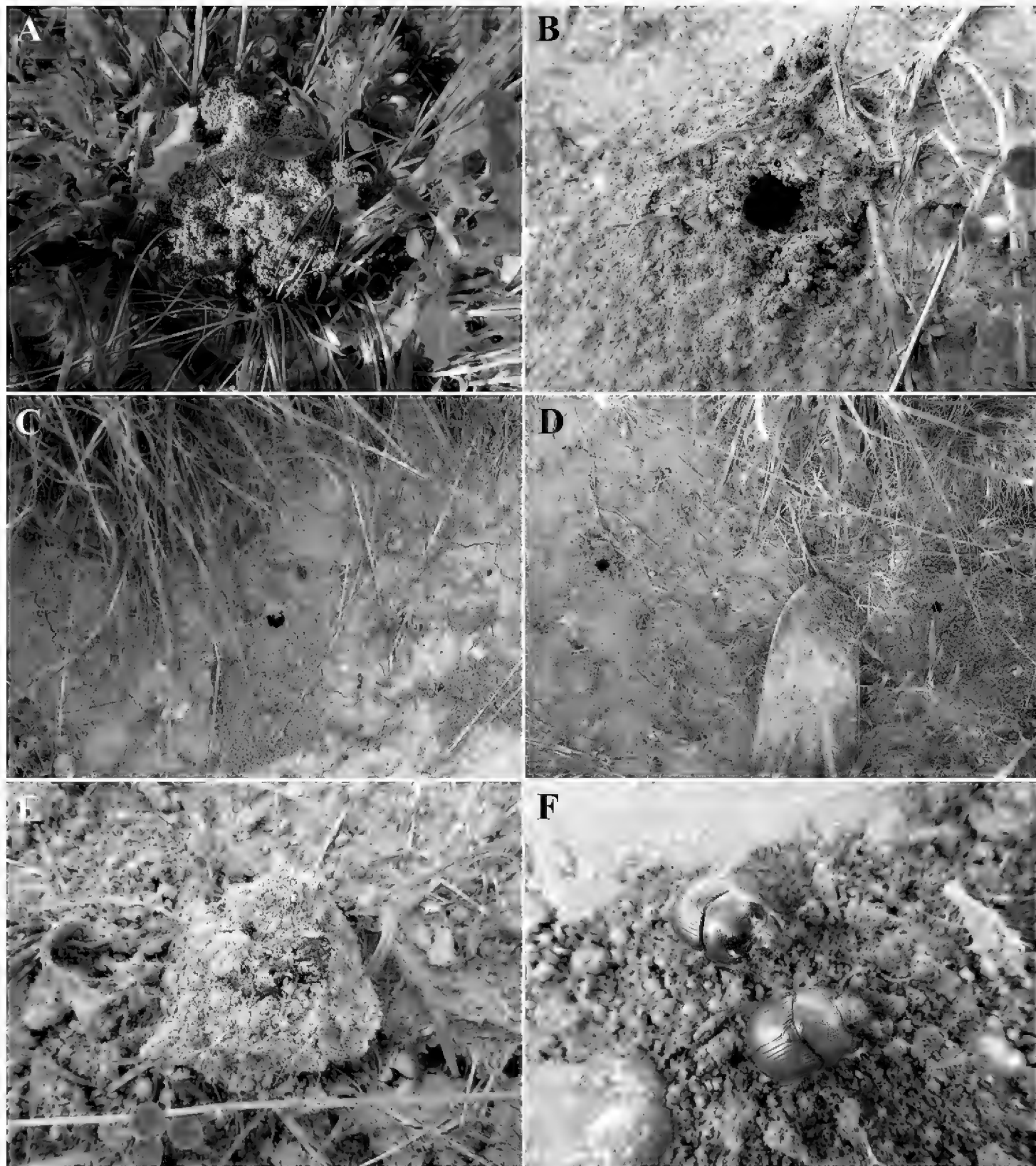


Figure 8. Excavation of *B. unicornis* at Čierna hora near Kamenica nad Hronom (Slovakia) **A–D** burrows dug by adults with push-ups (**A,B, D** photographed by Ondřej Sabol) **E, F** excavated pair (photographs by Ondřej Sabol).

very slowly ca. 20–100 cm above the ground at 20.50–21.20 CEST, DJP and PJP obs. (see Table 4 for full data on the flights); 5.viii.2011, 10 spec. FSLG at 20.50–21.10 CEST, DJP and PJP obs. (see Table 4 for full data on the flights); 6.viii.2011, 9 spec. FSLG at 20.40–21.00 CEST, DJP and PJP obs. (see Table 4 for full data on the flights); 9.viii.2011, 15 spec. FSLG at 20.45–21.05 CEST, DJP and IMO obs. (see Table 4 for full data on the flights); 11.viii.2011, 14 spec. FSLG at 20.40–21.05 CEST, DJP, RKP and DHP obs. (see Table 4 for full data on the flights); 12.viii.2011, 9 spec. FSLG at

20.40–21.05 CEST, DJP, ITV and PJP obs. (see Table 4 for full data on the flights); 13.viii.2011, 16 spec. FSLG at 20.30–21.05 CEST, DJP, ITV and PJP obs. (see Table 4 for full data on the flights); 16.viii.2011, 1 ♂ and 1 ♀ FSLG at 20.35–21.05 CEST, DJP and RKP obs. (see Table 4 for full data on the flights); 7.vi.2013, 13 ♂♂ and 9 ♀♀ FSLG at 21.20–21.45 CEST, together with 11 spec. of *Och. integriceps*, DJP, IMO and ZKM obs. (see Table 4 for full data on the flights); 8.vi.2013, 10 ♂♂ and 5 ♀♀ FSLG at 21.17–21.42 CEST, together with 3 spec. of *Od. armiger* and 12 spec. of *Och. integriceps*, DJP, IMO and ZKM obs. (see Table 4 for full data on the flights); 9.vi.2013, 3 spec. FSLG after sunset, IJN and VVO obs.; 12.vi.2013, 6 spec. excavated from their burrows, OSO obs. (Fig. 8B, D, E, F), and 15 spec. FSLG at 21.20–21.35 CEST, together with more spec. of *Od. armiger*, DJP, JZJ and OSO obs. (see Table 4 for full data on the flights); 13.vi.2013, 10 spec. excavated from their burrows under a small piles of pushed-up soil, OSO obs. (Fig. 8A), 1 spec flying ca. 1 m above the ground just before the sunset, VLP obs., and 9 spec. FSLG at 21.30–21.50 CEST, OSO, PJP, VLP and VKS obs.; 14.vi.2013, 4 spec. FSLG after sunset, DJP, DKP, LKM and VKS obs.; 15.vi.2013, ca. 490 m NNE of the hilltop of Čierna hora hill, 3 spec. FSLG at 21.30 CEST, DKP, VKS and ZKM obs., SW hillside of Čierna hora hill, 7 spec. FSLG at 21.20–21.45 CEST, two anonymous observers from the Czech Republic obs. (see Table 4 for full data on the flights); 15.vi.2013, 10 ♂♂ and 10 ♀♀ FSLG after sunset, BBO and BJO obs.; 19.vi.2013, 1 ♀ FSLG at 21.46 CEST, RMU and OSO obs.; 15.vi.2014, 1 ♀ FSLG after sunset, BBO; 17.vi.2014, 1 ♀ FSLG after sunset, BBO; 3.ix.2014, 1 ♀ excavated from its burrow (from a depth of ca. 10 cm) on a path, ONV obs., 5 ♂♂ and 3 ♀♀ flying ca. 30–100 cm above the ground at 19.52–20.07 CEST, together with 1 ♂ of *Od. armiger*, DJP and ONV obs. (see Table 4 for full data on the flights); 4.ix.2014, 3 ♂♂ and 1 ♀ excavated from their burrows (from a depth of ca. 10–25 cm) on a path, 8 ♂♂ and 5 ♀♀ FSLG at 19.51–20.16 CEST, together with 1 ♂ of *Od. armiger*, DJP and ONV obs. (see Table 4 for full data on the flights); 5.ix.2014, 1 ♂ excavated from its burrow (from a depth of ca. 8 cm) on the edge of a path, 2 ♂♂ and 2 ♀♀ flying ca. 30–80 cm above the ground at 19.47–20.04 CEST, together with 3 ♀♀ of *Od. armiger*, DJP and VKS obs. (see Table 4 for full data on the flights); 6.ix.2014, 1 ♂ and 4 ♀♀ excavated from their burrows (from a depth of ca. 10–25 cm) on a path and on a loess forest-steppe slope, DJP and VKS obs.; 9.ix.2014, 3 ♂♂ and 1 ♀ excavated from their burrows (from a depth of ca. 10 cm) on a path, DJP, JCM and IMO obs., 1 ♂ flying relatively quickly ca. 1 m above the ground at 19.43 CEST and 1 ♂ flying very slowly ca. 10 cm above the ground at 19.47 CEST, DJP and IMO obs. (see Table 4 for full data on the flights); 17.ix.2014, 2 ♀♀ excavated from their burrows (from a depth of ca. 10 cm) on a path, IMO obs.; 31.v.2015, 1 ♂ and 1 ♀ flying slowly 10–30 cm above the ground at 21.40–21.45 CEST, FTR obs.; 3.vi.2015, 1 ♂ excavated from its burrow on a loess forest-steppe slope, 1 ♀ flying slowly near the ground after sunset and 1 ♀ attracted to the light trap, APO obs.; 4.vi.2015, 1 ♂ excavated from its burrow on a loess forest-steppe slope, APO obs.; 5.vi.2015, 2 ♂♂ flying relatively quickly ca. 1 m above the ground at 21.22–21.27 CEST, together with 1 ♀ of *Od. armiger* and 1 spec. of *Och. integriceps*, DJP obs. (see Table 4 for full data on the flights); 6.vi.2015, 2 ♂♂ excavated

from a single burrow (from a depth of ca. 12 cm) and 1 ♀ excavated from another burrow (from a depth of ca. 25 cm) on a path (loess forest-steppe slope), 1 ♂ (length of body 9.5 mm!) and 1 ♀ flying relatively quickly ca. 120 cm above the ground at 21.24–21.29 CEST, together with 4 ♀♀ of *Od. armiger* and 1 spec. of *Och. integriceps*, and 1 ♂ flying slowly 10–20 cm above the ground at 21.47 CEST, DJP obs. (see Table 4 for full data on the flights); 28.v.2016, 6 spec. FSLG at 21.05–21.10 CEST, two anonymous observers from the Czech Republic obs. (see Table 4 for full data on the flights); 11.vi.2016, 2 ♂♂ and 3 ♀♀ FSLG at 21.20–21.40 CEST, JKP and VDP obs.; 47°50'4.038"N, 18°43'53.947"E, ca. 165 m a.s.l., 2.viii.2014, 1 ♂ FSLG at 21.15 CEST, RCR obs.; 47°50'9.08"N, 18°43'39.93"E, ca. 185 m a.s.l., 20.vi.2018, 4 ♂♂ and 2 ♀♀ FSLG after sunset (3 spec.) and at light (3 spec.), OSO obs.; Kamenica nad Hronom env., ca. 530 m NNE of the hilltop of Čierna hora hill, 47°50'26"N, 18°43'50.7"E, 180 m a.s.l., 30.v.2011, 1 ♀ FSLG after sunset, small steppe hillside near an oak forest, FSP obs.; Kováčov, [110 m a.s.l.], 8.viii.1965, 1 ♂, K[arel] Poláček leg., coll. MHKC; Chlaba, 11.vi.1985, 1 ♂ and 1 ♀ J. Hladný leg., coll. JZJ.

8178–8278: “Parkaň” [= Štúrovo], [ca. 110 m a.s.l.], 1934, no other data, 1 ♀ in coll. MHKC; 1940, no other data, 1 ♂ in coll. MHKC; Štúrovo, July 1967, 1 ♀, collector unknown, coll. ASH.

8179: Chlaba env., Močiar (the site near the confluence of the Danube and Ipel' rivers), 47°49'14.53"N, 18°50'52.72"E, 110 m a.s.l., 12.vi.2014, 1 ♂ FSLG at 21.40 CEST, together with 2 ♀♀ of *Od. armiger*, OSO obs.

7785: Cerová vrchovina Mts, Hajnáčka – Buková env., ca. 48°13'51.39"N, 19°58'26.32"E, 1.vi.1978, 1 ♂ crawling on the ground in the afternoon in sunlight, IJN leg. [storage of the specimen unknown]; Cerová vrchovina Mts, Hajnáčka – Buková env., “circular pasture under vággon” [ca. 48°13'43.88"N, 19°58'15.53"E], 23.vi.1990, 1 ♀ flying at 21.28 CEST, JVP leg., ex original coll. JVP, currently in coll. NMPC; Hajnáčka – western edge of the village, 48°12'48.2"N, 19°56'52.1"E, ca. 275 m a.s.l., 7.vi.2010, 1 ♀ FSLG after sunset, together with more spec. of *Od. armiger* and *Och. chrysomeloides*, PVP obs.; 8.vi.2010, 1 spec. FSLG after sunset, together with more spec. of *Od. armiger* and *Och. chrysomeloides*, PVP obs.; Hajnáčka – Buková env., steppe hillside (former sheep pasture with low and sparse vegetation, near an oak forest), 48°13'37.24"N, 19°58'23.73"E, 340–390 m a.s.l., 27.v.2008, 5 ♀♀ FSLG at 21.10–21.35 CEST, 22 °C, no wind, together with 20 spec. of *Od. armiger* and 19 spec. of *Och. chrysomeloides*, DJP and FSP obs. (see Table 5 for full data on the flights); 28.v.2008, 1 ♀ FSLG at 21.20 CEST, 18 °C, light air – light breeze, together with 10 spec. of *Od. armiger* and 9 spec. of *Och. chrysomeloides*, FSP obs.; 29.v.2008, 1 newly hatched (light coloured) ♂ crawling on the T-shirt spread out on the ground near the edge of the forest, under an oak tree (*Quercus cerris*) at 19.55 CEST, 1 ♂ flying relatively quickly and zigzag ca. 1 m above the ground and 3 ♀♀ flying slowly ca. 0.5 m above the ground at 21.10–1.40 CEST, 21 °C, no wind to light air, together with 20 spec. of *Od. armiger* and 14 spec. of *Och. chrysomeloides*, DJP, KDO and PJJ obs. (see Table 5 for full data on the flights); 30.v.2014, 1 ♂

FSLG at 21.10 CEST, 22 °C, almost no wind, together with 15 spec. of *Od. armiger* and 23 spec. of *Och. chrysomeloides*, DJP obs.; 28.vi.2009, 2 ♂♂ FSLG at 21.35 and 21.42 CEST, steppe hillside near an oak forest, together with 12 spec. of *Od. armiger* and 2 spec. of *Och. chrysomeloides*, OSO obs.; 29.vi.2009, 1 ♂ FSLG at 21.35 CEST, steppe hillside near an oak forest, together with 21 spec. of *Od. armiger* and 3 spec. of *Och. chrysomeloides*, OSO obs.; 4.vii.2009, 3 ♂♂ and 4 ♀♀ FSLG at 21.15–21.45 CEST, 22 °C, no wind, together with ca. 20 spec. of *Od. armiger* and ca. 15 spec. of *Och. chrysomeloides*, DJP and MBP obs. (see Table 5 for full data on the flights); 5.vii.2009, 1 ♂ and 2 ♀♀ FSLG at 21.15–21.30 CEST, 20 °C, no wind, together with ca. 10 spec. of *Od. armiger* and ca. 10 spec. of *Och. chrysomeloides*, DJP obs. (see Table 5 for full data on the flights); 6.vii.2009, 1 ♂ FSLG at 21:25 CEST, 21 °C, no wind, together with ca. 15 spec. of *Od. armiger* and ca. 10 spec. of *Och. chrysomeloides*, DJP obs.; 28.v.2010, 1 ♂ a 3 ♀♀ FSLG at 21.10–21.25 CEST, together with ca. 15 spec. of *Od. armiger* and ca. 25 spec. of *Och. chrysomeloides*, DJP obs. (see Table 5 for full data on the flights); 29.v.2010, 1 ♂ FSLG at 21.10 CEST, together with ca. 10 spec. of *Od. armiger*, DJP obs.; 7.vi.2010, 2 ♂♂ and 1 ♀ FSLG after sunset, FPT obs.; 48°13'30.26"N, 19°58'25.39"E, 305 m a.s.l., 20.vi.2020, 1 ♂ and 1 ♀ flying after sunset, JPH and TKH obs.; Hajnáčka, Tehliarske, 48°13'15.68"N, 19°57'45.57"E, ca. 270 m a.s.l., 8.viii.2014, 4 ♂♂ and 6 ♀♀ FSLG after sunset (ca. 21.07 CEST), RCR obs.; 8.vii.2015, 9 ♂♂ and 6 ♀♀ FSLG after sunset (ca. 21.11 CEST), RCR obs.; 29.vi.2017, 4 ♂♂ and 8 ♀♀ FSLG after sunset (ca. 21.07 CEST), RCR obs.; Hajnáčka, Lapos, 48°13'32.37"N, 19°57'50.58"E, ca. 350 m a.s.l., 24.vii.2020, 12 ♂♂ and 9 ♀♀ FSLG at 21.05–21.30 CEST, 15 °C, RCR obs.

7785–7885: Cerová vrchovina Mts, Gemerský Jablonec, 48°12'0.44"N, 19°59'24.31"E, 250–265 m a.s.l., steppe hillside with shrubbery of *Prunus spinosa* and *Rosa canina* on the hilltop, 4.vii.2009, 1 ♂ a 3 ♀♀ FSLG at 21.30–21.50 CEST, FPT and JPH obs. (see Table 6 for full data on the flights); 5.vii.2009, 3 ♂♂ a 1 ♀ FSLG at 21.30–21.50 CEST, FPT and JPH obs. (see Table 6 for full data on the flights); 28.v.2010, 1 ♂ and 3 ♀♀ FSLG at 21.00–21.15 CEST, ITV and MNB obs. (see Table 6 for full data on the flights); 29.v.2010, 1 ♂ and 1 ♀ FSLG after sunset, ITV and MNB obs.; 4.vi.2010, 1 ♂ FSLG at 21.30 CEST, together with 3 spec. of *Od. armiger*, ITV obs.; 8.vi.2010, 4 spec. FSLG after sunset, FPT and JPP obs.; 48°11'58.04"N, 19°59'23.71"E, 26.vi.2020, 1 spec. flying after sunset, JPH and TKH obs.; Gemerský Jablonec [env.], 5.vii.2013, 1 ♂ and 1 ♀, FPT leg., coll. GML.

7786: Cerová vrchovina Mts, Hostice – Katarínka env., 48°13'52.55"N, 20°5'0.82"E, 216 m a.s.l., small steppe hillside with rich low vegetation and shrubbery of *Prunus spinosa*, 6.vi.2010, 2 ♀♀, hovering on the spot ca. 20 cm above the ground at 21.15 and 21.30 CEST (25 spec. of *Od. armiger* and 4 spec. of *Och. chrysomeloides* were also observed at the site), DJP obs. (see Table 7 for full data on the flights); Cerová vrchovina Mts, Jestice env., 48°12'38.5"N, 20°03'07.3"E, 275 m a.s.l., 30.vi.2018, 1 ♂, 2.–3.vii.2018, 1 ♀, FPT and NKB leg., coll. GML; Jestice env., 48°12'54"N, 20°2'32"E, 6–7.vii.2019, 1 ♂ and 1 ♀ FSLG after sunset, JBB leg. (♀ in coll. IECA);

Jestice – Kökényes, 48°12'45.84"N, 20°2'50.77"E, 250 m a.s.l., 23.vi.2020, 1 ♂ flying after sunset, ABC obs.; 6.vii.2020, 1 ♂ and 1 ♀ flying after sunset, ABC obs.; Jestice – Ivánkúta env., 48°12'30.9"N, 20°5'5.37"E, 254 m a.s.l., 7.vi.2015, 2 ♂♂ FSLG at 20.25 CEST, edge of an oak forest, RCR obs.

7489: Slovak Karst, “Rakata” [= Rakyta Cottage] env., 48°35'29.7"N, 20°34'01.45"E, ca. 540 m a.s.l., 5.vii.1988, 1 ♀ excavated from its burrow, DKP (for partial data on this record see Hillert et al. 2016).

7390: Slovak Karst, Hrhov, E of Okružle hill, 48°36'48.83"N, 20°47'22.98"E, ca. 395 m a.s.l., 4.vii.1988, 2 ♂♂ excavated from their burrows, DKP (for partial data on this record see Hillert et al. 2016); Slovak Karst, Hrhov, E of Okružle hill, 48°36'55.5"N, 20°47'27.3"E, ca. 430 m a.s.l., 28.v.2012, 1 ♂ drowned in a puddle on the path connecting two forest-steppe meadows, MHP obs.

Comment

Slovakia is the country with the largest number of individuals found, as well as with the second largest number of known localities where the species has been recorded (52 sites). In addition to the already known localities, Endrődi (1957) mentioned Fehér Kárpátok [= The White Carpathians Mts], which most likely refers to two old records north of Trenčín (Nemšová – Ľuborča and Bolešov – Piechov) reported by Brancsik (1899, 1905), Laczó (1905), and Laco (1928). Most of the recent records are summarised by Juřena et al. (2008). New records from 26 Slovak localities are given in the present study. For the distribution of the species in Slovakia see Fig. 9.

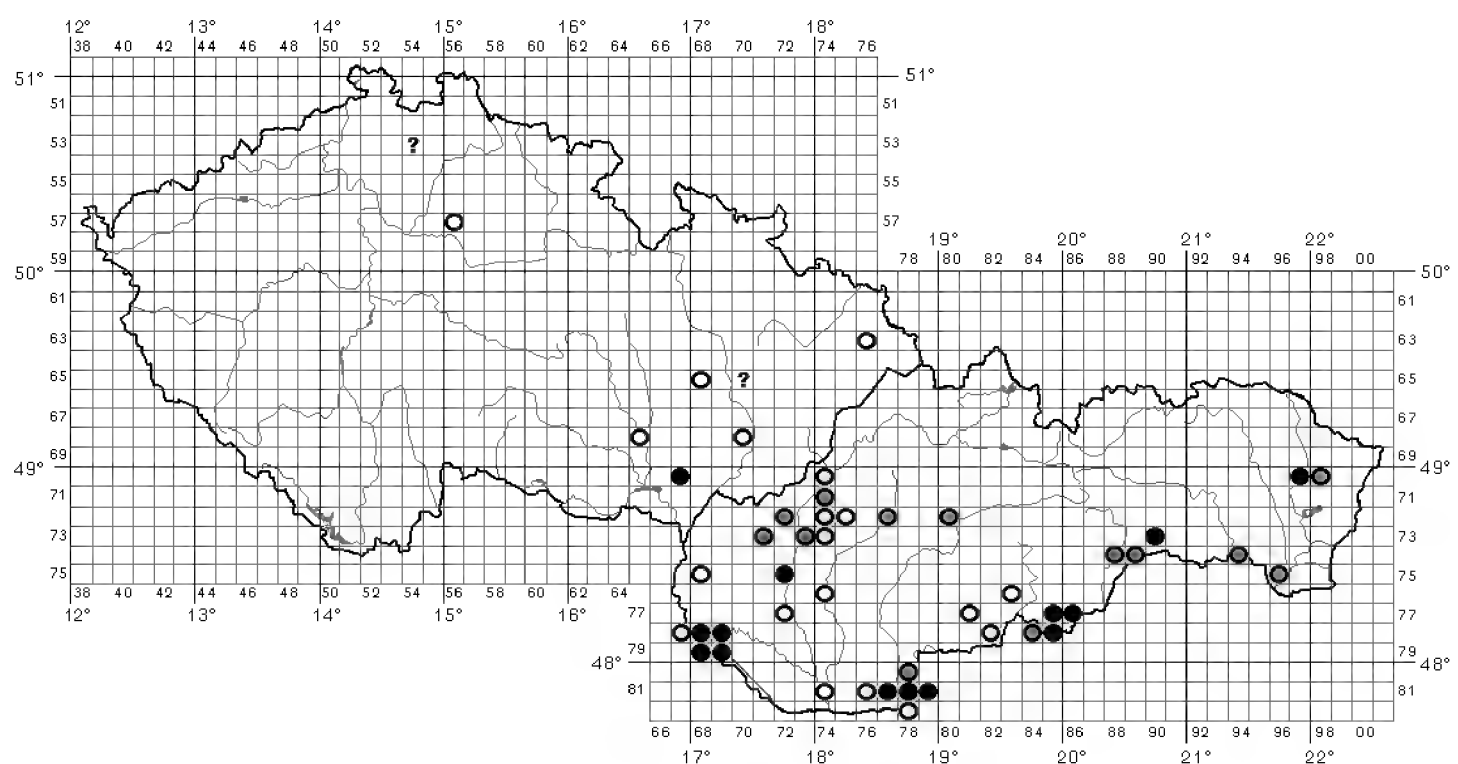


Figure 9. Distribution of *B. unicornis* in the Czech Republic and Slovakia (open circles refer to the records before 1960, open circles with a grey centre refer to the records between 1960–1999, and solid circles refer to the records after 1999; a question mark indicates a dubious record).

France

Published data

“Gallia”, no other data (Panzer 1802).

“Alsace”, no other data (Bedel 1911; Portevin 1931; Horion 1951; Peslier 2004; Callot 2018).

Grand Est, Bas-Rhin, Strasbourg, ca. 140 m a.s.l., “in coll. Dr Puton – Jules Bourgeois pers. comm.”, no other data (Scherdlin 1915; Sainte-Claire Deville 1936; Paulian 1941; 1959 Tesař 1957; Horion 1958; Paulian and Baraud 1982; Gangloff 1991; Brustel and Gouix 2012); Haut-Rhin, Colmar, ca. 195 m a.s.l., 25.vi.1967, 1 ♂, flew through the open window attracted by light, Schlatter leg. (Gangloff 1991; Brustel and Gouix 2012); Haut-Rhin, Mulhouse, no other data (Kampmann 1860; Knörzer 1912, Schaufuss 1916; Paulian 1941, 1959; Paulian and Baraud 1982), 1 ♂, undated, [Hans W.] Kesenheimer leg. (Scherdlin 1915; Gangloff 1991; Brustel and Gouix 2012), Haut-Rhin, Mulhouse – Dornach, ca. 250 m a.s.l., no other data, Klein leg. (Scherdlin 1920; Sainte-Claire Deville 1936; Paulian 1941, 1959; Horion 1958; Paulian and Baraud 1982), August (year not specified), 1 spec., collector unknown, coll. [Édouard] Klinzig (Gangloff 1991; Brustel and Gouix 2012); Haut-Rhin, Mulhouse – Tannenwald, ca. 300 m a.s.l., undated, several spec. excavated from their burrows, Oscar Koechlin leg. (Bourgeois 1904; Knörzer 1912; Huber 1916; Sainte-Claire Deville 1936; Paulian 1941, 1959; Horion 1958; Paulian and Baraud 1982); Haut-Rhin, Riedisheim, ca. 280 m a.s.l., July 1912, 2 spec., collector not specified (Sainte-Claire Deville 1936; Horion 1958), 15.vi.1949, 1 spec., [Édouard] Klinzig leg. (Gangloff 1991; Brustel and Gouix 2012); Haut-Rhin, Baldersheim, ca. 230 m a.s.l., 26.viii.1951, 4 spec., Burglin leg., coll. [Édouard] Klinzig (Gangloff 1991; Brustel and Gouix 2012).

? **Auvergne-Rhône-Alpes**, Savoie, Albertville, 19th century, no other data, 1 ♂ and 1 ♀ in coll. Perroud deposited in MNHN (Brustel and Gouix 2012; according to Denis Keith pers. comm., 2020, this record is dubious – see also the comment below).

Material examined

? “S. Frankreich” [= south of France], 1 ♂ and 1 ♀, “Coll. C. Felsche, Kauf 20, 1918”, coll. MTDG [locality probably mistaken].

Grand Est, “Alsatia” [= Alsace], no other data, 1 ♂ in coll. Antoine Boucomont deposited in MNHN; Bas-Rhin, Strasbourg, [ca. 140 m a.s.l.], no other data, 1 ♂ in coll. MHNG (cf. Scherdlin 1915; Sainte-Claire Deville 1936; Paulian 1941, 1959; Tesař 1957; Horion 1958; Paulian and Baraud 1982); Haut-Rhin, Mulhouse – Dornach, [ca. 250 m a.s.l.], August [year not specified], 1 ♂, coll. MZSF (see Gangloff 1991); Haut-Rhin, Riedisheim, [ca. 280 m a.s.l.], 15.vi.1949, 1 ♂, [Édouard] Klinzig [leg.], coll. MZSF (cf. Gangloff 1991); Haut-Rhin, Baldersheim, ca. 230 m a.s.l., 26.vii.1951, 2 ♀♀, collector not specified [probably Burglin leg. – see Gangloff 1991], coll. MZSF.

? **Occitanie**, “Francia, Montpellier”, 1918, 1 ♀, Lavagne [leg.], coll. Paolo Luigioni deposited in MCZR [locality probably mistaken].

Comment

For France, *B. unicornis* was first recorded by Panzer (1802) without precise data. Up to now, it is reliably known only from Alsace, with the last record from Colmar in 1967 (Gangloff 1991). Brustel and Goux (2012) reported two specimens from the 19th century from the Savoy Prealps (Albertville), which, according to Denis Keith (pers. comm.), is dubious and probably based on mislabelled material. The site (a mountainous area) does not meet the known requirements of the species and its occurrence here seems to be highly improbable. The same applies to the Mont Cenis specimen from the Abeille de Perrin's collection in the MNHN.

Germany

Published data

Baden-Württemberg, Markgräflerland, Neuenburg am Rhein – Grifflheim, “Grifflheimer Trockenaue”, [ca. 47°52'18.3"N, 7°33'55.5"E, ca. 210 m a.s.l.], 2.vi.1967, 1 ♂, at light, Hans Messmer leg., photo + coll. Richard Disch (Brechtel et al. 1995; Krell 1998; Bense et al. 2000; Frank and Konzelmann 2002; Petersen et al. 2006).

Bavaria (Bayern), “Bavaria”, no other data (Panzer 1793a, 1795); “Bayern”, no other data (Reitter 1909; Kuhnt 1912; Huber 1916; Horion 1951; Geiser 1984); “Bavaria”, no other data, 1 ♂ (ex original coll. Rudolf Veselý) in coll. NMPC (Hillert et al. 2016); Unterfranken, Aschaffenburg – Strietwald, ca. 130 m a.s.l., 1830, more spec., Dr Hoffmann leg. (Oechsner 1854; Kittel 1879; Ihssen 1935; Horion 1951, 1957, 1958) – note: Fröhlich (1897) and Knörzer (1912) consider record from Aschaffenburg to be doubtful; Oberbayern, Neuburg an der Donau – Bergheim, ca. 380 m a.s.l., 9.vii.1946, 1 spec. and 20.vii.1954, 1 spec., Rudolf Müller leg., coll. NMAG (Jungwirth 2005, 2012); ? Oberbayern, Ingolstadt, September 1892, 1 spec. K[arl] Daniel leg. (Horion 1957, 1958; Jungwirth 2005; see Material examined and new observations below).

Material examined and new observations

“Germ.” [= Germany], no other data, 1 ♂ and 1 ♀ in coll. ZINR, 1 ♀ in coll. Karel Mazura deposited in MMBC.

“Germania” [= Germany], no other data, 1 ♂ in coll. Georg Frey deposited in NHMB, 1 ♂ in coll. Ladislav Bojčuk deposited in MHKC, 1 ♂ in coll. NHMD.

“Germania mer.”, no other data, 1 spec in coll. ZSMG.

Baden-Württemberg, Bruchsal – Untergrombach, Michaelsberg and Habichtsbuckel Nature Reserve, ca. 49°5'32"N, 8°34'13"E, 200–220 m a.s.l., 3.vii.2021, 1 ♀, light trap, FTK and TBK obs., 4.vii.–5.viii.2021, 17 ♂♂ and 11 ♀♀ FSLG after sunset, together with more spec. of *Od. armiger* and *Och. chrysomeloides*, FTK and TBK obs. (5 spec. leg., coll. FTK, TBK and SMNK) – these records will be published with additional details at a later date (Florian Theves and Torsten Bittner pers. comm., 2021).

Bavaria (Bayern), Upper Bavaria (Oberbayern), Ingolstadt, [ca. 370 m a.s.l.], 9.ix. [18]92, 1 spec. Dr K[arl] Daniel [leg.], “Fundortverwechslung” [= locality mistaken], coll. ZSMG (see Horion 1957, 1958; Jungwirt 2005); ? Oberbayern, “Holzapfelkr.” [= Holzapfelkreuth, former manor on the western outskirts of Munich], [ca. 550 m a.s.l.], 12.x. [19]12, H[ans] Kulzer [leg.], “Fundortverwechslung” [= locality mistaken], coll. ZSMG.

Comment

In addition to old records from the late 18th and the first half of the 19th centuries from Bavaria, only one record from Baden from 1967 and two records from Bavaria in 1946 and 1954 were known from Germany. Daniel’s specimen from Ingolstadt and Kulzer’s speci-



Figure 10. Findings of *B. unicornis* **A, B** Germany, Bruchsal – Untergrombach, Michaelsberg and Habichtsbuckel Nature Reserve, 7.vii.2021 (photographs by Torsten Bittner) **C, D** Bulgaria, Dimovo env., 26.vi.2010 (photographs by Aleš Sedláček) **E, F** Bulgaria, Oreshak env., 6.vii.2020, (photographs by Maximilian Teodorescu).

men from Munich are questionable because they bear the labels added later of “Fundort-verwechslung” (= locality mistaken). The new records presented from Baden represent the first known data on the species’ occurrence in Germany after 54 years (see also Fig. 10A, B).

Switzerland

Published data

Basel-Stadt (Kanton Basel-Stadt), Basel, undated, 1 spec., Ed. Bernoulli leg. (Heer 1841; Stierlin and Gautard 1867; Stierlin 1900; Huber 1916; Brustel and Gouix 2012).

? Republic and Canton of Ticino (Repubblica e Cantone Ticino), no other data, Villa [leg.] (Heer 1841; Stierlin and Gautard 1867; Stierlin 1900); given that the canton of Ticino is mountainous, this record does not seem credible (see Habitat preferences in this study).

Material examined

Canton of Zürich (Kanton Zürich), “Tigurini” [= Zürich], undated, 2 ♀♀, collector unknown, “Mus. Drews.” [= Musaeum Drewseni, = ex coll. Christian Drewsen (1799–1896)], coll. NHMD (Fig. 11).

Comment

The two old records from Basel and Canton of Ticino were later considered questionable for the absence of any subsequent sightings (Allenspach 1970). Both editions of the Catalogue of Palaearctic Coleoptera (Král et al. 2006; Nikolajev et al. 2016) list Switzerland for *B. unicornis* probably on the basis of these records. *Bolbelasmus unicornis* is no longer included in the very recent checklist of Scarabaeoidea of Switzerland (Cosandey et al. 2017). The two specimens from Zürich deposited in NHMD confirm the historical occurrence of the species in the country.

Italy

Published data

“Italia”, no other data (Panzer 1802).

“Italia borealis”, no other data (Cristofori and Jan 1832).

Piedmont (Piemonte), no other data (Marseul 1857; Jacquelin du Val 1863; Baudi di Selve 1889; Bertolini 1899a; Bedel 1911; Luigioni 1929; Porta 1932; Horion 1958; Arnone and Massa 2010; Brustel and Gouix 2012; Carpaneto et al. 2021), 2 spec., no other data (Costa 1864), 3 ♂♂ and 1 ♀, [19th century], [Vittore] Ghiliani leg., coll. MSNG, 1 ♂, [19th century], “ex coll. Demarchi”, [Flaminio] Baudi [di Selve] [leg.], coll. MSNG, 1 ♂ with no other data in coll. NMPC (Arnone and Massa



Figure 11. The only two specimens of *B. unicornis* so far known from Switzerland, deposited in NHMD (photographs by Caroline Amalie Høegh-Guldberg, edited by Peter Kurina).

2010; Ballerio et al. 2014; Hillert et al. 2016; data from MSNG specified and supplemented by Roberto Poggi pers. comm., 2021), 1 ♂, [Flaminio] Baudi [di Selve] [leg.], and 1 ♂, L. Carrara [leg.], no other data, coll. MNFI (Arnone and Massa 2010; Hillert et al. 2016); Torino env., cattle pastures, date not specified, 2 spec. flying after sunset, together with *Od. armiger* and *Och. chrysomeloides*, Vittore Ghiliani leg. (Ghiliani 1847, 1887); Torino env., June 1845, 1 spec. on the bank of the Po River after a flood, Vittore Ghiliani leg. (Ghiliani 1847, 1887); Torino, 1 spec., no other data (Horion 1958; Barbero and Cavallo 1999); Torino, alluvial materials of the Po river, ca. 230 m a.s.l., 2 spec., no other data, coll. A. Gagliardi deposited in MFSN (Barbero and Cavallo 1999; information on the storage of these specimens supplemented by Enrico Barbero pers. comm., 2021); Provincia di Cuneo, Montelupo Albese, 24.v.1978, 1 ♂, collector not specified, coll. MCAS (Barbero and Cavallo 1999; Carpaneto et al. 2016; information on the storage of this specimen specified by Enrico Barbero pers. comm., 2021); Provincia di Alessandria, Lerma, 21st century, no other data (Carpaneto et al. 2016; Glerean and Stefani 2019); Provincia di Novara, Bellinzago Novarese, Caserma

Valentino Babini env., ca. 45°33'4"N, 8°39'59"E, ca. 185 m a.s.l., 1982–1989, number of spec. not specified, Roberto Pescarolo leg. et det. (Pescarolo 1990).

Lombardy (Lombardia), no other data, (Bertolini 1872, 1899a; Luigioni 1929; Porta 1932; Horion 1958; Brustel and Gouix 2012; Carpaneto et al. 2021); “Milano” [= Milan], [ca. 120 m a.s.l.], [19th century], 1 ♂ and 1 ♀, “ex coll. A[chille] Griffini”, no other data, coll. MSNG (Arnone and Massa 2010; Hillert et al. 2016; data specified by Roberto Poggi pers. comm., 2021).

Trentino-Alto Adige/Südtirol, “Tirol” [= probably Südtirol], [Stefano de] Bertolini leg. (Gredler 1863), Südtirol, no other data (Horion 1958); Provincia autonoma di Trento, Trento env., [ca. 190 m a.s.l.], September 1868, 1 [♂], plant materials alluviated by the flooded Adige River, together with *Od. armiger*, Stefano de Bertolini leg. (Bertolini 1871, 1874; note: in the first paper from 1871, Bertolini did not include *B. unicornis* in the list of identified species, but he added it in his later article from 1874) – this specimen, labelled “92”, is still in the Bertolini’s collection deposited in MUSE; ? Provincia autonoma di Trento, Torcegno env., “in the mountains above Torcegno”, undated, 3 spec., together with *Od. armiger*, [Giovanni] Costesso leg., coll. Stefano de Bertolini (Bertolini 1891, 1899b) – this record seems improbable due to the very high altitude (ca. 1000–2300 m) of the area (cf. Habitat preferences in this study); Provincia autonoma di Bolzano, “Bozen Boden” [an urban area of Bolzano in the east of the city], [ca. 260 m a.s.l.], undated, 1 spec., coll. Vinzenz Maria Gredler (Gredler 1863; Peez and Kahlen 1977; Kahlen 2018; note: in the Gredler’s collection deposited in FGBI, the space for “*Bolb. quadridens*” in the box is empty – Daniel Lorenz pers. comm., 2021; in MSNB there are no specimens of *B. unicornis* – Petra Kranebitter pers. comm., 2021); Venezia Tridentina, no other data (Luigioni 1929; Porta 1932); Trentino, no other data (Arnone and Massa 2010; Brustel and Gouix 2012).

Veneto, no other data, (Bertolini 1872, 1899a; Luigioni 1929; Porta 1932; Horion 1958; Arnone and Massa 2010; Brustel and Gouix 2012).

Friuli Venezia Giulia, Provincia di Pordenone, Magredi del Cellina, Cordenons env., ca. 116 m a.s.l., 8.ix.2018, 1 ♂ and 1 ♀, dead on a path, 9.ix.2018, 1 ♂ and 1 ♀ in flight at 20.10–20.30 CEST (air temperature 21.5 °C, humidity 81%), 1 ♀ at actinic light at 21.15 CEST (air temperature 20 °C, humidity 96%), 10.ix.2018, 1 ♂ in flight at 20.15 CEST (air temperature 19 °C, humidity 78%), 12.x.2018, 1 ♀ in flight at 20.00 CEST, 15.v.2019, 1 ♂ and 1 ♀ in flight at 21.15 CEST (air temperature 14 °C, humidity 75%), 16.v.2019, 2 ♂♂ and 1 ♀ in flight at 21.00–21.15 CEST (air temperature 17 °C), 1 ♀ crawling on the ground at 21.20 CEST, 24.v.2019, 5 ♂♂ in flight at 21.20–21.35 CEST (air temperature 20 °C, humidity 70%), 26.v.2019, 1 ♂ in flight at 21.20–21.35 CEST (air temperature 20 °C, humidity 70%), 1.vi.2019, 1 ♂ and 2 ♀♀, in flight at 21.40 CEST (air temperature 20 °C, humidity 80%), 6.vi.2019, 2 ♂♂ and 1 ♀, in flight at 21.00–21.20 CEST (air temperature 22 °C, humidity 80%), 7.vi.2019, 2 ♂♂ in flight at 21.35 CEST (air temperature 22 °C, humidity 50%), Paolo Glerean and Gabriele Stefani obs. (Glerean and Stefani 2019; for flight statistics see Table 9); Provincia di Udine, Pasian di Prato, Biotopo prati del Lavia, ca. 90 m a.s.l., 15.–31.v.2005, 1 ♀, pitfall trap, Pietro Zandigiacomo leg. (Zandigiacomo 2005; Lapini et al. 2013).

Tuscany (Toscana), no other data, coll. Dr L[ucas] von Heyden (Heyden 1884); 1 spec. with no other data (Horion 1958); 1 ♀ with no other data in coll. OHS (Hillert et al. 2016).

Material examined and new observations

“Ital.” [= Italy], no other data, 1 ♀ in coll. MNBG.

“Italia borealis”, 1 ♂, “ex coll. [Achille] Griffini”, no other data, coll. MSNG.

“Italien” [= Italy], “coll. [Gustav] Kraatz”, no other data, 2 ♂♂ and 5 ♀♀ in coll. SDEI.

“Italia”, undated, 1 ♂ and 1 ♀ (ex coll. Alexander Fry), coll. NHML.

“Italia, Sella [it is not clear whether it is a geographical name or the name of a person]”, no other data, 1 ♂ in coll. SDEI.

Piedmont (Piemonte), “Pedem.”, [= Pedemontium, currently Piedmont], no other data, 1 ♂ in coll. RBIN; “Pedemt.” [= Piedmont], no other data, 3 ♂♂ and 1 ♀ in coll. Maurice Pic deposited in MNHN; “Pedemont.” [= Piedmont], no other data, 1 ♂ and 1 ♀ (ex coll. Christian Drewsen) in coll. NHMD, 1 ♂ (ex coll. Carl Gustaf Thomson) in coll. MZLU, 1 spec. in coll. NHMW; “Pedemont.” [= Piedmont], undated, L[éon Marc Herminie] Fairm[aire] [leg.], 1 ♂ and 1 ♀ (ex coll. Fredrik Wilhelm Mäklin) in coll. FMNH; “Alp. Pedemont.” [= Alpes Pedemontium], undated, 2 ♂♂ and 1 ♀, [Vittore] Ghiliani [leg.], coll. NHMD; “Piémont” [= Piedmont], undated, 1 ♂ in coll. Elzéar Abeille de Perrin deposited in MNHN, 1 ♀ in coll. Antoine Boucomont deposited in MNHN, 1 ♀ in coll. Jacques Baraud deposited in MNHN, 1 ♂ in coll. NMPC, 1 ♀, in coll. Alfonz Gspan deposited in PMSL, 1 ♂ (ex coll. Giacomo Doria, ex coll. Edward Bonney Nevins) in coll. NHML; “Piemont” [= Piedmont], no other data, 1 ♂ and 1 ♀ in coll. MNBG, 1 ♂ and 1 ♀ in coll. RBIN; “Piemont” [= Piedmont], “coll. Rottenberg”, 1 ♀ in coll. SDEI; “Piemont” [= Piedmont], “coll. [Carl] Felsche”, 1 spec. in coll. MTDG; “Piemonte” [= Piedmont], “colezz. Alzona” [= coll. Alzona], 1 ♀ in coll. MSNM; Città metropolitana di Torino, Rivarossa, [ca. 285 m a.s.l.], no other data, 1 ♀ in coll. Leopold Mader deposited in MNSA; “Turin” [= Torino], no other data, 1 ♂ and 2 ♀♀ in coll. Sylvain Augustin de Marseul deposited in MNHN, 1 ♂ and 1 ♀ in coll. NHMD, 1 spec. in coll. ZSMG; Torino, 25.vii.[year not specified], no other data, 1 ♂ in coll. Georg Frey deposited in NHMB; Torino, “alluvioni Po” [= alluvial materials of the Po river], ca. 230 m a.s.l., 1871, 1 ♀, L. Fea leg., coll. MSNG; Torino, no other data, 1 ♂ in coll. FMNH, 1 spec. in coll. NHMW; Borgofranco d’Ivrea, [ca. 250 m a.s.l.], undated, 1 ♂, L. Demarchi leg., coll. MSNG; Provincia di Alessandria, Lerma, ca. 300 m a.s.l., May 1995, 1 ♂, in the morning accidentally dug up from the soil in the orchard; 8.iv.2014, 1 ♂, in the morning accidentally dug up from the soil in the orchard; 4.v.2014, 1 ♂ in the morning on the ground and 1 ♀ at UV light at 21.30 CEST, after several days of rain; 11.v.2014, 1 ♀, accidentally dug up from the soil in the garden at 16.00 CEST; 3.viii.2014, 1 ♀ flying around the light at 21.30 CEST; 16.v.2015, 1 ♂, at UV light at 21.30 CEST, rain in the morning and the day before, very wet, 17 °C; 17.v.2015, 1 ♂, at UV light at 21.15 CEST, wet, 17 °C; 20.vi.2015, 1 ♀, at UV light at 22.00 CEST, heavy rainfall in pre-

vious days, vegetation and soil heavily saturated with water, 17 °C; 21.vi.2015, 1 ♀, at UV light at 22.00, wet, 17 °C; 29.vi.2015, 1 ♀, at UV light at 21.50 CEST, 23 °C, LRL obs. (see Glerean et al. 2021).

Lombardy (Lombardia), Provincia di Varese, Casorate Sempione, ca. 280 m a.s.l., October 1958, 1 ♂, at light, A. Bilardo leg., ex original coll. Giovanni Mariani, currently deposited in coll. RPM (for partial data on this record see Ballerio 2008 and Ballerio et al. 2014). Note: Zilioli and Pittino (2004) reported that in 2000 Riccardo Pittino unsuccessfully attempted to rediscover the species at this locality.

Comment

In the collection of Zdeněk Tesař deposited in SNMS, there is one specimen with the locality “Tirolis”, which may refer to the territory of South Tyrol (today Trentino-Alto Adige). Records from Sicily (Baraud 1977; Paulian and Baraud 1982; Carpaneto and Piattella 1995; Sparacio 1995; Barbero and Cavallo 1999; Martín-Piera and López-Colón 2000; Agoglitta et al. 2006; Trnka 2009; Arnone 2010; Alonso-Zarazaga et al. 2013; Schoolmeesters 2019; Nuß and Jäger 2020) refer to *Bolbelasmus vaulogeri* (Abeille de Perrin, 1898) (see Arnone and Massa 2010 and Hillert et al. 2016). Benasso’s record from Luint, Friuli-Venezia Giulia (Benasso 1971) is apparently based on a misidentified specimen of *Bolbocerosoma* sp. (bearing an erroneous locality label), which is evident both from the drawing of the specimen and from its description; in addition, this specimen was allegedly lost (Paolo Glerean pers. comm., 2020). This study presents new records from the third known locality with a recent occurrence of the species in Italy (Lerma).

Poland

Published data

Mazovian Voivodeship (Województwo mazowieckie), Warsaw – Saska Kępa, 80–85 m a.s.l., undated, 2 spec., Antoni Waga leg. (Hildt 1896; Tenenbaum 1923; Kubicka 1981; Szwalko 2004; Byk et al. 2012, 2016).

Opole Voivodeship (Województwo opolskie), Opole County, Złotniki, ca. 155 m a.s.l., undated, 1 ♀, Ludwik Fryderyk Hildt leg. (Hildt 1896; Szwalko 2004; Byk et al. 2016).

Świętokrzyskie Voivodeship (Województwo świętokrzyskie), Kielce County, Chęciny, 1 spec., no other data, (Tenenbaum 1923; Szwalko 2004; Bidas 2012; Byk et al. 2012, 2016; for details on this record see Material examined below); Ostrowiec County, Skarbka, 9.viii.1973, 1 ♂, dug up from the soil on a meadow, A. Liana, coll. MIZP (Stebnicka 1976; Szwalko 2004; Byk et al. 2016); Sandomierz County, Góry Pieprzowe Nature Reserve, ca. 150 m a.s.l., 28.vi.2001, 1 ♀, at light, KPL (Bunalski et al. 2013).

Lublin Voivodeship (Województwo lubelskie), Lublin env., no other data, Baumgarten leg. (Hildt 1896; Szwalko 2004; Byk et al. 2016).

Material examined

Lesser Poland Voivodeship (Województwo małopolskie), Wadowice County (Powiat wadowicki), “Wadowice, Hal.” [= Hałyczyna or Galicja (Galicja), Wadowice, ca. 250–300 m a.s.l.], 1 ♀, undated, Smolik [leg.], DJP det., coll. NMBE.

Świętokrzyskie Voivodeship (Województwo świętokrzyskie), Kielce County, “Góry Stokrzyskie [env.], Gałęzice, [Mt.] Góra Ostrówka” [currently the Ostrówka quarry, ca. 50°50'11.94"N, 20°24'46.38"E, ca. 250 m a.s.l.], July 1921, 1 ♂, J. Czarnocki [leg.], “Polonia, [coll.] Sz[ymon] Tenenbaum”, coll. MIZP (for incomplete data on this record see Tenenbaum 1923; Szwalko 2004; Byk et al. 2012, 2016).

Comment

From Poland, only six records were known, which are summarised and specified by Byk et al. (2016). The last Polish record is from 2001 from the Góry Pieprzowe Nature Reserve (Bunalski et al. 2013). This study presents a previously unpublished historical record from Wadowice.

Austria

Published data

Upper Austria (Oberösterreich), Linz, Scharlinz, ca. 250 m a.s.l., 25.v.1936, 1 ♂, [Johann] Wirthumer leg., coll. BZLA (Mitter 2000; Schwarz 2008; sex specified by Martin Schwarz pers. comm., 2022); Linz, Weikerlsee, ca. 250 m a.s.l., 10.vii.1955, 1 ♂ and 3 ♀♀, after the flood, [Hermann] Haider leg., coll. BZLA (Mitter 2000; Schwarz 2008; sexes specified by Martin Schwarz pers. comm., 2022); Linz – Ebelsberg, bank of the Traun river, 10.vii.1954, 9 spec., F. Linzinger leg., 4 spec. in coll. HMS, 5 spec. [3 ♂♂, 2 ♀♀] in coll. BZLA, Linz env., undated, 2 spec. [1 ♂ and 1 ♀], [Emil] Munganaust leg., coll. BZLA (Franz 1974; Mitter 2000; Schwarz 2008; sexes specified by Martin Schwarz pers. comm., 2022); Steyregg, ca. 250 m a.s.l., 1 ♀ with no other data, coll. BZLA (Franz 1974; Mitter 2000; Schwarz 2008; sex specified by Martin Schwarz pers. comm., 2022); bank of the Danube river between the villages of Steyregg and Pulgarn, driftwood, no other data (Dalla Torre 1879; Schwarz 2008); Saxen an der Donau, 21st century, no other data (Paill and Mairhuber 2012; Gimpl et al. 2020).

Lower Austria (Niederösterreich), no other data (Panzer 1793b; Sturm 1805); Mühling, ca. 260 m a.s.l., no other data, Arthur Schatzmayr leg. (Schatzmayr 1936; Benasso 1971); Schauboden env., Hochrieß, ca. 370 m a.s.l., end of July 1955, 1 ♂, F. X. Seidl leg., Rudolf Petrovitz det. et coll. (Ressler and Kust 2010); Melk, undated, 2 spec., [Josef] Breit leg. (Horion 1958; Franz 1974); Mödling env., Eichkogel hill., ca. 330 m a.s.l., no other data (Franz 1974; Schmölzer 1989); Weidling bei Wien, no other data (Duftschmid 1805); Wienerwald, Weidlingbach, undated, 2 spec., [Josef] Breit leg. (Horion 1958; Franz 1974); [Vienna env.,] “Donau-Auen”, undated, 3 spec.,

[Franz] Blühweiss leg. (Pittioni 1943; Horion 1958); Donau-Auen National Park, Orth an der Donau env., 48°7'59.87"N, 16°42'20.56"E, 145 m a.s.l., 6.–8.vii.1997, 1 ♀, plant materials alluviated by flooded Danube river, PZW obs. + photo (Paill 2007; coordinates specified by PZW pers. comm., 2009); Groß-Enzersdorf – Mühlleiten env., 48°10'34"N, 16°33'6.6"E, 159 m a.s.l., 24.vi.2019, 1 ♂ flying up to 0.5 m above the ground at 21.40 CEST, meadow adjacent to the forest, 22 °C, gentle breeze, ADW obs. + photo (Dostal 2019; Dostal and Barries 2019; Dostal et al. 2021b); Leitha Mts, Mannersdorf am Leithagebirge env., July 1900, 1 ♀ and October 1912, 1 ♀, in a forest clearing, Molitor leg. (Horion 1958; Franz 1974); Oberweiden, Sandberge Oberweiden Nature Reserve, 48°17'15.4"N, 16°49'38.5"E, ca. 155 m a.s.l., 23.viii.2019, 1 ♀ perching motionless on a path at 19.00 CEST, 25 °C, DRW and SRL leg., det et coll. (Rabl et al. 2019); Marchegg, ca. 135 m a.s.l., no other data (Franz 1974).

Vienna (Wien), no other data, coll. Dr Lucas von Heyden (Heyden 1884); no other data, (Dobiasch 1911); “Umg. Wien” [= Vienna env.], undated, 1 ♀, Ad[olf] Hoffmann [leg.], coll. ZFMK (Hillert et al. 2016); Vienna, Danube inundation area, 17.vii.1906, 3 spec., collector not specified (Franz 1936, 1974); Vienna XXI [– Floridsdorf], August 1948, 12 spec., plant materials alluviated by flooded Danube river, [Harald] Schweiger leg. (Horion 1958); Vienna – Floridsdorf, ca. 155 m a.s.l., June 1949, 1 spec., at light in the garden, Harald Schweiger leg. (Schweiger 1951; Horion 1958; Franz 1974); Vienna env., Kahlenberg hill, no other data (Franz 1974); Vienna – Donaustadt, Fuchshäufel, 48°11'45.5"N, 16°28'57.9"E, 160 m a.s.l., 26.vi.2019, 1 ♂ flying up to 0.5 m above the ground at 21.55 CEST, 25 °C, no wind, WBW and ADW leg. + photo (Dostal 2019; Dostal et al. 2021a, b); Vienna – Donaustadt, Müllergraben, ca. 48°11'24.6"N, 16°30'42.4"E, 150 m a.s.l., 21.vi.2019, 1 spec., pitfall trap with vinegar, KFW leg. (Dostal 2019; Dostal et al. 2021a, b); Vienna – Donaustadt, Schusterau, 48°10'33.7"N, 16°32'54.7"E, 163 m a.s.l., 25.vi.2019, 1 ♀ flying up to 0.5 m above the ground at 21.50 CEST, 24 °C, no wind, WBW and ADW leg. + photo (Dostal 2019; Dostal et al. 2021a, b); Donau-Auen National Park, Untere Lobau, W of Kreuzgrund [= Lausgrund], ca. 48°9'34.52"N, 16°31'42.94"E, 152 m a.s.l., 15.vi.–9.vii.2006, 1 ♀, pitfall trap, Wolfgang Paill obs. (Paill 2007; Dostal et al. 2021b); Vienna – Donaustadt, Kreuzgrund, 48°9'36"N, 16°32'42"E, 160 m a.s.l., 12.vi.2019, one burrow, ADW and ADW obs.+ photo (Dostal 2019; Dostal et al. 2021a, b).

Burgenland, shore of Neusiedler See, plant materials amassed by flood water, several times (according to Sturm), with no further details (Petrovitz 1956); Winden am See, foot of the Zeilerberg mountain, ca. 200 m a.s.l., 3.vi.1981, 1 spec., at light, Gerhard Rößler leg. (Rößler 1989); Günser Gebirge, Rechnitz env., area of Geschriebenstein, no other data, Alfonz Freh leg. (Kasab 1937; Horion 1958; Franz 1974); Jois env., steppe meadows north of the town, [ca. 220 m a.s.l.], 11.viii.2021, 1 ♂ flying up to 0.5 m above the ground and 1 ♀ in light trap, 21 °C, no wind, ADW and WBW obs. (Dostal and Barries 2021).

Carinthia (Kärnten), Villach, Teufelsgraben, 1 spec. with no other data (Holdhaus and Prossen 1901; Horion 1958; Paill and Mairhuber 2006); Villach env., undated, 1 spec., Arthur Schatzmayr leg. (Prossen 1913; Schatzmayr 1936; Horion 1958; Benasso 1971; Paill and Mairhuber 2006).

Styria (Steiermark), Grazer Bergland, Hörgas [near Gratwein-Straßengel], undated, 1 ♂ [10.6 mm], G[ustav] Wallaberger Sr. leg., coll. UMJG (Horion 1958; Franz 1974; Holzer 2019; sex specified by the author); Leutschach, Glanzer Klapotetzstraße 74 (Biohof Gunczy), 46°39'17.518"N, 15°31'18.03"E, ca. 370 m a.s.l., 8.ix.2018, 1 ♀, at light (flew through the open window), J. Gunczy obs., photo Gernot Kunz (Holzer 2019).

Material examined

“Styria” [= Duchy of Styria, a territory that included the modern Austrian state of Styria and the Slovenian region of Lower Styria], 1858, 1 ♂, [Eduard Albert] Bielz [leg.], coll. BNMS.

Lower Austria (Niederösterreich), “Nied. Oesterr.” [= Niederösterreich], no other data, 1 ♂ in coll. NMBE; Melk, undated, 23 spec. in coll. NHMW, 1 ♂ and 1 ♀ (ex original coll. Josef Breit, Vienna) in coll. Georg Frey deposited in NHMB, 1 ♂ (ex original coll. Rudolf Petrovitz) in coll. MHNG (cf. Horion 1958 and Franz 1974); Wachau, no other data, 1 spec. in coll. NHMW; Wienerwald, Weidlingbach, undated, 2 ♂♂ (ex original coll. Josef Breit, Vienna) in coll. Georg Frey deposited in NHMB (cf. Horion 1958 and Franz 1974); “Umg. Wien” [= Vienna env.], Wienerwald, 1 spec. in coll. NHMW; “Blumau, Steinfeld” [= Blumau near Neurißhof], [ca. 250 m a.s.l.], undated, 1 ♂ (ex original coll. Rudolf Petrovitz) in coll. MHNG; [Vienna env.], “Donau-Auen”, undated, 1 ♂ and 1 ♀, F[ranz] Blühweiss leg., 1 ♂ and 1 ♀, Fr. Reiss leg., ex original coll. Rudolf Petrovitz, currently in coll. MHNG; [Vienna env.], Donauauen, no other data, 1 ♀ in coll. TLMF, 10 spec. in coll. NHMW; [Vienna env.], Donauauen, undated, 1 ♀, F[ranz] Blühweiss [leg.], coll. MNBG; “Marchfeld, Oberweiden”, no other data, 1 ♀ in coll. MNBG; Oberweiden, Steppe [= steppe], 7.viii.1959, 1 ♀, J[osef] Gusenleitner leg., coll. BZLA.

Vienna (Wien), “Wien” [= Vienna], no other data, 2 ♀♀ in coll. Vladimír Zoufal deposited in MMBC, 1 spec. in coll. MTDG, 1 ♀ in coll. BZLA; “Wien” [= Vienna], undated, 1 ♂, J[osef] Moser leg., coll. BZLA; “Vienne” [= Vienna], no other data, 1 ♂ and 1 ♀ in coll. Albert Sicard deposited in MNHN; “Wien Umg.” [= Vienna env.], no other data, 1 ♂ in coll. Leopold Mader deposited in MNSA; “Wien, Umgeb.” [= Vienna env.], undated, 1 ♀, F. Schade [leg.], coll. Jaroslav Matoušek deposited in MMBC; “Wien Umgebung”, undated, 2 ♂♂, A[dolf] Hoffmann leg., coll. TLMF; “Umg. Wien” [= Vienna env.], undated, Ad[olf] Hoffmann [leg.], 1 ♀ (ex coll. P. Franck) in coll. MIZP, 1 ♂ in coll. SMNS, 1 ♀ in coll. Alfons Gspan deposited in PMSL; “Hochwasser bei Wien” [= flood near Vienna], no other data, 1 ♀ (ex coll. Adolf Hoffmann) in coll. Jan Roubal deposited in SNMS; Vienna, Donau [= Danube river], Hochwasser [= flood], undated, 1 ♂ (ex original coll. Rudolf Petrovitz) in coll. MHNG; Vienna, “Donauüberschwemmung” [= flooded Danube river], September 1920, 1 spec., R. F. Lang [leg.], coll. NHMW; Vienna env., undated, 1 ♀, Carl Mandl [leg.], coll. Georg Frey deposited in NHMB; Vienna env., undated, 1 ♂, Matuschka [leg.], ex original coll. Josef Breit (Vienna), currently in coll. Georg Frey deposited in NHMB; Vienna, “Inundationsgebiet” [= inundation area of the Danube river], undated, 3 spec. (ex original coll. Herbert Franz) in coll. NHMW, 1 ♂ (ex original coll. Josef Breit, Vienna) in coll. Georg Frey deposited in NHMB; Vienna, Prater, no other data, 1 spec. in coll. NHMW.

Comment

In Austria, this species is known from six of the nine Austrian states. A recent attempt to rediscover the species at suitable sites along the Traun River in Upper Austria (Link et al. 2011) was unsuccessful, probably due to the use of inappropriate collecting methods and ignorance of the species' bionomy. This study presents previously unpublished older data from three Austrian localities.

Hungary

Published data

Western Transdanubia (Nyugat-Dunántúl), Vas County, “Molna-Szecsőd” [= Molnaszecsőd], 10.vi. [turn of the 19th and 20th century], ca. 180 m a.s.l., 1 spec. inside the digestive system of *Cuculus canorus*, Ernő Csiki obs. (Csiki 1904); Vas County, Kőszegi-hegység, no other data (Endrődi 1957); Zala County, Nova, ca. 190 m a.s.l., no other data (Endrődi 1957).

Central Transdanubia (Közép-Dunántúl), Komárom-Esztergom County, “Szöny” [a part of the current Komárom city], 6.viii.1901, 2 spec. inside the digestive system of *Upupa epops*, Ernő Csiki obs. (Csiki 1905); Komárom-Esztergom County, “Ószöny” [= Szöny, the part of the current Komárom city], ca. 105 m a.s.l., no other data (Endrődi 1957); Komárom-Esztergom County, Esztergom, 1 ♂, Sebő Endrődi leg., coll. HNHM (Endrődi 1957; Nádai 2006; sex specified by VKS pers. comm., 2020); Komárom-Esztergom County, Csolnok, no other data (Endrődi 1957), 28.v.1898, 1 ♂, Zahradka leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Oroszlány env., Majkpuszta, Majki-hegy, 14.vi.1997, 1 ♀, at light. CKZ (Kutasi 2002; Nádai 2006; Eichardt and Kutasi 2011); Fejér County, Velence – Kisvelence, ca. 115 m a.s.l., July 1940, 1 ♀, Rudolf Lenczy leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Fejér County, Adony, no other data (Endrődi 1957), 1 ♂, undated, Viktor Stiller leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020).

Southern Transdanubia (Dél-Dunántúl), Somogy County, Fonyód, ca. 140 m a.s.l., undated, 1 ♂, Viktor Stiller leg., coll. HNHM (Endrődi 1957; Nádai 2006; sex specified by VKS pers. comm., 2020); Somogy County, Ordacsehi, Csehi-berek, 21.vii.2004, György Rozner leg. (Nádai 2006); Somogy County, Kaposvár, no other data (Endrődi 1957), 8.vii.1931, 1 ♂, Miklós Nattán leg., coll. HNHM (Hillert et al. 2016), 22.v.1951, 1 ♂, 3.vi.1951, 1 ♂, 4.vii.1951, 1 ♂, 31.vii.1958, 1 ♂, 19.v.1960, 1 ♀, Miklós Nattán leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Somogy County, Balatonföldvár, no other data (Endrődi 1957); Somogy County, Nagyberény, 1937, 1 ♂, Ferenc Lichtneckert leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Somogy County, Balatonvilágos – Balatonaliga, 1.viii.1980, collector unknown, 1 spec. in coll. HNHM (Nádai 2006; data specified by OMB pers. comm., 2020); Somogy County, Szenna, 9.vi.1998, György Rozner leg. (Rozner 2001; Nádai 2006); Tolna County, Gyulaj, 1 ♂, 1952, Jenő Györffy leg.,

coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Tolna County, Hőgyész, 46°30'38"N, 18°25'55"E, 24.vii.1994, 1 spec. at light, collector not specified (Nádai 2006; coordinates specified by SBP, pers. comm. 2021); Tolna County, Bataapáti env., Nagy-mórággyi-völgy [valley], Quercetum, 15.vii.2004, 1 ♀, OMB leg., coll. HNHM (Nádai 2006; Hillert et al. 2016); Tolna County, Bonyhád, ca. 140 m a.s.l., 8.vii.1938, 1 spec., Nándor Vámos leg., coll. ZUDH (Enyedi 2006); Baranya County, Szigetvár, ca. 120 m a.s.l., no other data (Endrődi 1957), 1.vi.1909, remains of 1 spec., Ottó Mihók leg., coll. HNHM (Nádai 2006; data specified by VKS pers. comm., 2020); Baranya County, Sellye, finding in truffle (*Tuber* sp.), no other data (Merkl 2014); Baranya County, Pécs, no other data, (Viertl 1894; Kuthy 1898; Endrődi 1957), 1 ♂, undated, Ferenc Ehmann leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Baranya County, "Szabolcs" [= Pécs – Szabolcs or Mecsekszabolcs] env., "Szarvasnóta", ca. 46°8'8"N, 18°15'46"E, beginning of June 1880, 1 ♂ and 1 ♀, the female was digging a hole into the ground at the edge of a forest footpath like *Copris*, and it seemed that the male was helping her with this work, Dr Ernő Kaufmann leg. (Kaufmann 1897, 1914a, b); Baranya County, Abaliget, 1978, no other data (Nádai 2006); Baranya County, Villányi-hegység Mts, Csukma-hegy hill, 5.v.1972, 1 spec. at light (mercury-vapor lamp), Ákos Uherkovich leg. (Horvatovich 1980; Sár and Horvatovich 2000; Nádai 2006).

Central Hungary (Közép-Magyarország), Veszprém County, Pápa env., no other data (Wachsmann 1907; Endrődi 1957), 1893, 1 ♀, Ferenc Wachsmann leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020), June 1895, 1 ♀, Ferenc Wachsmann leg., coll. HNHM (Rozner 1984; Nádai 2006; sex specified by VKS pers. comm., 2020); Veszprém County, Balatonalmádi, 5.ix.1940, 1 ♂, Ernő Csiki leg., coll. HNHM (Rozner 1984; Nádai 2006; sex specified by VKS pers. comm., 2020); Veszprém County, Vászoly env., Öreg-hegy, 250–290 m a.s.l., 3.vii.1999, 1 spec., IRB leg. (Nádai 2006; data specified by OMB pers. comm., 2020); Veszprém County, Paloznak 17.viii.1961, Frigyes Novák leg., coll. HNHM (Rozner 1984; Nádai 2006); Veszprém County, Berhida, undated, 1 ♀, Rudolf Lenczy leg., coll. HNHM (Rozner 1984; Nádai 2006; sex specified by VKS pers. comm., 2020); Pest County, Buda hills (Budai-hegység), no other data (Frivaldszky I. 1865; Frivaldszky J. 1879a, b; Endrődi 1957); Pest County, Buda Hills, Hármashatárhegy [env.], [47°32'50.21"N, 19°0'18.77"E, ca. 390 m a.s.l.], 31.v.2004, 1 ♂, caught after sunset with a net attached to the roof of a moving car, OMB leg., coll. HNHM (Hillert et al. 2016; data specified by OMB pers. comm., 2020); Pest County, "Kis-Szent-Miklós" or "Őrszentmiklós" [= Őrbottyán – Őrszentmiklós], 1876, dry oak forest on the hill, 1 spec. on the ground in the grass in the evening (localised thanks to audible stridulation), Karoly Sajó leg. (Sajó 1881, 1897, 1910a, b), 1880s, more spec., sons of Karoly Sajó leg. (Sajó 1897, 1910b); Pest County, Sződliget, 16.vi.2005, 1 spec., Tamás Hácza leg. (Nádai 2006; data specified by OMB pers. comm., 2020); Pest County, Pilis hegység, no other data (Endrődi 1957); Pest County, Pilis hegység, Szentendre env., undated, 1 ♀, Hugó Diener leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Pest County, Szigetszentmiklós, 6.vi.1954, 1 ♀, Miklós Nattán leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Pest County, Dabas, no other data

(Frivaldszky 1865; Kuthy 1898; Endrődi 1957); Pest County, Dabas – Gyón env., [47°9'6.08"N, 19°18'6.84"E, ca. 100 m a.s.l.], 20.v.2012, 1 spec., at light, SIB leg. (Merkl and Szénási 2018; coordinates specified by OMB pers. comm., 2020); Pest County, Táborfalva env., shooting and training area, [47°5'52"N, 19°23'26"E, 118 m a.s.l.], 11.vii.2012, 1 spec., at light, SIB obs. (Merkl and Szénási 2018; coordinates specified by SBP pers. comm., 2021); Pest County, Gödöllő env., no other data (Pétsch and Szénási 2019); Pest County, Gödöllő env., Valkó, 22.vii.1992, 1 spec., clearing in an oak forest, László Köteles leg. (Köteles and Bakonyi 1996; Nádai 2006); Pest County, Gödöllő – Máriabesnyő, no other data (Endrődi 1957), 31.v.1912, 1 ♂, István Gurányi leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Pest County, Gödöllő, 55 Erdőszél Street, [47°36'11.3"N, 19°23'23.6"E, 250 m a.s.l.], 2005, no other data, VSI leg., (Nádai 2006); Pest County, Gödöllő env., Faház-tető hill, no other data, VSI leg., (Nádai 2006); Pest County, Pécel, no other data (Kuthy 1898; Endrődi 1957; Pétsch and Szénási 2019), 1 ♀, undated, István Peregi leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); 47°29'11.48"N, 19°23'19.52"E, 3.vi.1972, 1 spec., IRB leg. (Nádai 2006; data specified by OMB pers. comm., 2020); Pest County, Isaszeg, no other data (Endrődi 1957; Pétsch and Szénási 2019); 29.v.1909, 1 ♂, 2.vi.1909, 1 ♂, Ottó Mihók leg., coll. HNHM (Nádai 2006; corrections and sex specified by VKS pers. comm., 2020); 1908, 1 ♀, 1909, 1 ♀, June 1917, 1 ♂, Hugó Diener leg., coll. HNHM (Nádai 2006; corrected and sex specified by VKS pers. comm., 2020); June 1929, 1 spec., Hugó Diener leg., coll. HNHM (Nádai 2006); 2008, 1 ♀, collector not specified, coll. HNHM (Hillert et al. 2016); June 2013, more spec. FSLG after sunset, TNB obs. + photo (Németh 2013); Pest County, Isaszeg, 29 Erdő Street, [47°31'23.412"N, 19°23'33.87"E, 210 m a.s.l.], 2005, VSI leg. (Nádai 2006); Pest County, Kistarcsa env., no other data (Pétsch and Szénási 2019); Pest County, Kerepes env., no other data (Pétsch and Szénási 2019); Pest County, Domony env., no other data (Pétsch and Szénási 2019); Pest County, Csévharaszt, [47°18'26"N, 19°26'26"E, 127 m a.s.l.], 14–15.viii.2001, 3 ♂♂ and 1 ♀, pitfall traps with ethylene glycol and at light, GSB leg., coll. HNHM (Nádai 2006; Szél and Kutasi 2011; Hillert et al. 2016; data specified by VKS pers. comm., 2020, and SBP pers. comm., 2021), 17.vi.2002, 1 spec., at light, SIB obs., 19.vi.2004, 1 spec., at light, SIB obs., 29.v.2005, 1 spec., at light, SIB obs. (Nádai 2006; Szél and Kutasi 2011; data specified by OMB pers. comm., 2020); Pest County, Biatorbágy, 27.vi.1999, 1 ♂, at light, AGB leg., coll. HNHM (Nádai 2006, Hillert et al. 2016; data specified by VKS pers. comm., 2020); Pest County, Nagykovácsi env., Julianna-major, 10.vi.1985, 1 spec., at light, 18.vii.1985, 1 spec., at light, Dezső Szalóki leg. (Nádai 2006); Pest County, Budakeszi, 28.v.1991, on *Glomus macrocarpum*, no other data (Bratek et al. 1992); Pest County, Budakeszi env., Hosszú-dűlő, 200 m a.s.l., 5.vi.1991, 2 ♀♀, on *Glomus macrocarpum*, *Cynodonto-Festucetum*, LAB leg. coll. HNHM (Nádai 2006; data specified by VKS pers. comm., 2020), 8.vi.1991, 2 ♀♀, on *Glomus macrocarpum*, *Cynodonto-Festucetum*, LAB leg., coll. HNHM (Nádai 2006; Hillert et al. 2016); Pest County, Budakeszi env., airport, 5.vi.1991, 1 ♀, LNB (Nádai 2006); Pest County, “Nógrádverőce” [= Verőce], Borbély-hegy hill, 1 ♂, summer 1916, municipal forest, Sebő Endrődi leg., coll. HNHM (Endrődi 1957, 1979; Nádai 2006; sex specified by VKS pers. comm., 2020); Buda

[currently western part of Budapest], “Graberl” [a historical excursion destination in the Buda surroundings], 13.v.1798 (!), 1 spec., Tóbiás Koy leg. (Horváth 1884; this record is a quotation from the unpublished diary of János Boehm, the pioneer of Hungarian entomology); Budapest, no other data (Kuthy 1898); Budapest, 22.v.1930, no other data, Hugó Diener leg. (Nádai 2006); Budapest – Hűsérbiavösvölgy, 9.vi.1939, 1 ♀, József Stahulják leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Budapest env., Kamaraerdő, 25.iv.1920, 1 ♂ and 30.v.1922, 1 ♀, Hugó Diener leg., coll. HNHM (Nádai 2006; data specified by VKS pers. comm., 2020); [Budapest –] Rákos, no other data (Frivaldszky 1879a, b); Budapest – Budafok, no other data (Endrődi 1957), 1 ♂ with no other data, coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Budapest – Cinkota, no other data (Endrődi 1957), July 1907, 1 ♀, Kálmán Szombathy leg., coll. HNHM (Nádai 2006; sex specified by VKS pers. comm., 2020); Budapest – Mártonhegy, 17.iii.1949, 1 ♂, József Szőcs leg., coll. HNHM (Nádai 2006; Hillert et al. 2016); Budapest – Békásmegyer, 27.vi.1954, 1 spec., 29.vi.1954, 1 spec. and 1.vii.1954, 1 spec., Attila Podlussány leg., coll. MMGH (Nádai 2006; Enyedi and Ádám 2009); Budapest – Normafa, 9.vi.1967, 1 spec., Kálmán Gaskó leg. (Nádai 2006; data specified by OMB pers. comm., 2020); Budapest – Nagytétény, undated, 1 ♂, Sebő Endrődi leg., coll. HNHM (Endrődi 1957; Nádai 2006); Budapest – Ördög-órom, 2.vi.1959, 1 spec., Kálmán Gaskó leg. (Nádai 2006; data specified by OMB pers. comm., 2020); Budapest – Rákosszentmihály, 15.viii.1930, 1 ♂, at light, Jenő Győrffy leg., coll. HNHM (Nádai 2006; data specified by VKS pers. comm., 2020); Budapest – Szépvölgy, 23.vi.1975, OMB leg. (Nádai 2006); “Pest” [currently eastern part of Budapest], no other data, 1 ♀ in coll. NMEG (Hillert et al. 2016).

Southern Great Plain (Dél-Alföld), Csongrád-Csanád County, Szeged – Kiskun-dorozsma env., Nagyszék, 16.–23.vi.1989, 1 spec., pitfall trap with ethylene glycol, Béla Gaskó leg., coll. MMSH (Nádai 2006; Gaskó 2008); Békés County, Bélmegyer env., Fáspuszta, 46°53'42.19"N, 21°11'8.55"E, 1967, 1 spec., at light, no other data (Merkl et al. 2014; Merkl 2015; details specified by TDS pers. comm., 2021); Békés County, Dombegyház env., Trianon border mound, 46°18'17.54"N, 21°8'43.38"E, 99 m a.s.l., 9.vi.2013, 1 ♂, pitfall trap on a narrow strip of grass with loess soil, TDS and TDB leg., coll. HNHM (Merkl et al. 2014; details specified by TDS pers. comm., 2021); Bács-Kiskun County, “Peszér” [= Kunpeszér] env., no other data (Frivaldszky 1865; Endrődi 1957); Bács-Kiskun County, Csávoly, 10.vi.1999, 1 spec., at light, collector not specified (Nádai 2006; Merkl 2015).

Northern Hungary (Észak-Magyarország), Heves County, Mátra Mts, Galyatető, 10.vii.1959, Sándor Szabó leg. (Nádai 2006); Borsod-Abaúj-Zemplén County, Aggtelek National Park, Jósvalő env., 48°29'46"N, 20°33'53"E, 300 m a.s.l., 8.vii.1980, 1 spec., Iván Gyulai leg. (Nádai 2006; data specified by OMB pers. comm., 2020 and SBP pers. comm., 2021).

Northern Great Plain (Észak-Alföld), Hajdú-Bihar County, “Debrecen” [= Debrecen] env., ca. 1860–1880, 1 spec., József Török leg. (Török 1882); Hajdú-Bihar County, Debrecen, 10.vii.1958, 2 spec., Imre Tatár leg., coll. ZUDH (Enyedi 2006); Szabolcs-Szatmár-Bereg County, “Szabolcs vármegye” [= Szabolcs County], no other data (Szlabóczky and Borbás 1900).

Material examined and new observations

Western Transdanubia (Nyugat-Dunántúl), Győr-Moson-Sopron County, Győr – Likócs env., ca. 47°42'52.5"N, 17°41'45"E, 2019, 115 m a.s.l., pitfall traps, no other data (see unpublished report for the Fertő-Hanság National Park Directorate, Anonymus 2019); Győr – Györszentiván env., 47°42'42.17"N, 17°46'25.05"E and 47°42'51.18"N, 17°46'40.77"E, 110 m a.s.l., 10.vi.2016, 5 spec., pitfall traps, CSS and PKB leg. [storage of the specimens not specified]; 47°42'51.04"N, 17°46'40.24"E, 112 m a.s.l., 25.v.2019, 1 ♂, pitfall trap, CSS and PKB leg. [storage of the specimen not specified].

Central Transdanubia (Közép-Dunántúl), Fejér County, Csór, ca. 150 m a.s.l., 21.v.2014, 1 ♀, at light on a steppe, MPK leg., coll. DCO; 28.v.2016, 1 ♂, at light, DVZ obs.; Fejér County, Csákerény, Bucka hill, 47°20'51.65"N, 18°21'35.32"E, 230 m a.s.l., 11.vi.1987, 1 spec., at light, CSB obs.; Fejér County, Gánt env., Köves-völgy [valley], 47°24'19.94"N, 18°22'47.67"E, 280 m a.s.l., 14.vi.2019, 1 ♀ flying after sunset, VSI obs.; Fejér County, Nagykarácsony, 46°52'49.4"N, 18°43'27.1"E, 150 m a.s.l., 2.vi.2021, 2 ♂♂ and 1 ♀ FSLG after sunset, 17–18 °C, light breeze, TDS obs.; Fejér County, Adony env., 47°5'17.2"N, 18°49'10.3"E, 120 m a.s.l., 1.vi.2021, 10 spec. FSLG after sunset, 11–15 °C, no wind, TDB and TDS obs.; Komárom-Esztergom County, Környe, no other data, 1 ♂ in coll. RBIN; Komárom-Esztergom County, Esztergom env., Kis-Strázsa-hegy hill, 47°44'59.210"N, 18°44'35.07"E, 210 m a.s.l., 23.iv.2006, 1 spec., at light (mercury-vapor lamp), VPB; Komárom-Esztergom County, Keszölc env., 47°43'13.4"N, 18°47'43.3"E, 17.x.2014, 260 m a.s.l., 1 ♀ excavated from its burrow from a depth of 60 cm, loess steppe with abundant occurrence of *Lethrus apterus* (Laxmann, 1770), TVP (for incomplete data on this record see Hillert et al. 2016); Komárom-Esztergom County, Máriahalom env., Siklóernyő-hegy hill, 47°37'38.57"N, 18°41'20.38"E, 214 m a.s.l., 11.vi.2019, 1 ♂ and 1 ♀ flying after sunset, VSI obs. (♂ in coll. HNHM); Komárom-Esztergom County, Máriahalom env., 47°37'28.3"N, 18°41'21.68"E, 190 m a.s.l., 31.vii.2020, 1 ♀, at light, BKL obs. + photo (DJP det.); Veszprém County, Nagyvázsöny env., 47°1'40.73"N, 17°42'38.62"E, 315 m a.s.l., 12.vi.2009, 1 ♀ flying ca. 10 cm above the ground after sunset, KLP; 16.vi.2016, 3 ♂♂ FSLG after sunset, JHH, JPP, JSU MSZ, MPV and PIL obs.; Veszprém County, Vászoly env., Öreg-hegy, 250–290 m a.s.l., 3.vii.1999, 1 spec., IRB leg., coll. SZM; Veszprém County, Örvényes, 46°55'8.3"N, 17°48'26.07"E, 150 m a.s.l., 16.vi.2019, 1 ♀ flying after sunset, forest pasture, VSI obs.; Veszprém County, Felsőörs, Öreg-hegy, 47°0'57.59"N, 17°58'52.72"E, 214 m a.s.l., 7.viii.2018, 1 ♂, dead near the light in a garden, FKD obs. + photo (DJP det.); Veszprém County, Bakony Mts, Litér, [ca. 200 m a.s.l.], 14.vii.2014, 1 ♀, IRB leg., coll. GML.

Southern Transdanubia (Dél-Dunántúl), Somogy County, Balatonendréd, 46°50'52"N, 17°59'18"E, 174 m a.s.l., 11.v.1989, 1 ♀ excavated from its burrow together with 1 ♂ of *Od. armiger*, VRH; Somogy County, Ságvár, Jaba-völgy [valley], 46°49'28.29"N, 18°2'32.93"E, 180 m a.s.l., 25.ix.2017, 1 ♀ crawling on the

ground, PFS obs. + photo (DJP det.); Somogy County, Balatonvilágos – Balatonaliga, 10.vi.1983, 1 spec., at light, SIB obs.; Baranya County, Zselic Mts, Mozsgó, ca. 150 m a.s.l., 27.vii.2017, 1 ♂, at light, MRM; Baranya County, Drávaszabolcs, 4/c Köztársaság tér Street, 45°48'20.95"N, 18°12'43.74"E, 91 m a.s.l., 28.vi.2020, 1 ♀ dead under the lamp, JST; Baranya County, Villányi-hegység Mts, Nagyarsány env., Szársomlyó hill, ca. 145 m a.s.l., 22.v.1977, 1 ♂, at light., AUP; Baranya County, Erdősmecske, ca. 240 m a.s.l., 18.viii.2012, 1 spec., 31.vii.2016, 1 spec., 27.v.2017, 1 spec., REE obs.

Central Hungary (Közép-Magyarország), Pest County, Zsámbék, June 2016, 1 ♀, students of Department of Zoology, Charles University, Prague leg., coll. DKP deposited in NMPC; Pest County, Batorbágy, 47°27'54.501"N, 18°51'0.515"E, ca. 190 m a.s.l., 24.vii.2021, 1 ♂, at light, GAB obs. + photo (DJP det.); Pest County, Nagymaros env., Rigó-hegy hill, 47°46'31.63"N, 18°56'11.65"E, ca. 300 m a.s.l., 21.iv.2019, 1 ♂, night sweeping, TNB leg., coll. HNHN; Pest County, Szentendre – Izbég env., 47°41'47.61"N, 19°1'40.06"E, 195 m a.s.l., 9.vi.2014, 1 spec., at light (mercury-vapor lamp), GBP and APE obs.; Pest County, Pócsmegyer env., 47°43'44.5"N, 19°6'25.7"E, 110 m a.s.l., 11.viii.2006, 1 spec., 20.vi.2008, 1 spec., 18.vi.2010, 1 spec., pitfall traps without attractant, SBP and ZBP leg., 16.ix.2014, 1 ♀, pitfall trap, SBP leg. [storage of the specimens unspecified]; Pest County, Pomáz env., Szamár-hegy hill, 47°39'28.7"N, 18°58'43.06"E, ca. 185 m a.s.l., 2.vii.2019, 1 ♂ flying after sunset, VSI obs.; Pest County, Pomáz, Majdánpola, 47°38'27.7"N, 19°0'18.61"E, 190 m a.s.l., 1.viii.2019, 1 ♂ at light (mercury-vapor lamp), SIB obs., 1 m FSLG after sunset, VSI leg., coll. HNHN; Pest County, Budakeszi env., Hosszú-dűlő, 200 m a.s.l., 5.vi.1991, 2 ♂♂ and 1 ♀, *Cynodonto-Festucetum*, on *Glomus macrocarpum*, LAB leg., coll. GML (pair) and JMB (1 ♂); Pest County, Budakeszi, 5.vi.2013, 1 spec., 6.vii.2014, 1 spec., 19.vii.2014, 1 spec., 26.vii.2014, 1 spec., 3.vi.2015, 1 spec., 28.v.2016, 1 spec., 4.vi.2018, 1 spec., all at light, SIB obs.; Pest County, Budakeszi, gliding airport, ca. 200 m a.s.l., 5.vii.1991, 1 spec., LNB leg., coll. SZM; Pest County, Budakeszi, Farkas-hegy env., gliding airport, 47°28'39.7"N, 18°54'50"E, ca. 200 m a.s.l., 6.v.2018, 2 ♂♂ flying after sunset, TNB obs. (1 ♂ in coll. HNHN); 23.v.2019, 1 m flying after sunset, 12.vi.2019, 1 ♀, night sweeping, 17.vi.2019, 1 ♂, night sweeping, 27.vi.2019, 1 ♂, night sweeping, 2.vii.2019, 1 ♀ flying after sunset, TNB obs., 22.ix.2019, 1 spec., TNB obs., 47°28'55.2"N, 18°55'6.25"E, 18.vi.2018, 2 ♂♂ and 1 ♀ flying after sunset, 20.vi.2018, 4 ♀♀ flying after sunset, 5.vii.2018, 2 ♂♂ and 3 ♀♀ flying after sunset, 10.vii.2018, 2 ♂♂ flying after sunset, 12.ix.2018, 1 ♂ excavated from its burrow, TNB leg., coll. HNHN; Pest County, Budakeszi – Nagyszénászug, ca. 47°29'11.6"N, 18°55'26.3"E, ca. 230 m a.s.l., 18.vi.2018, 1 spec., 9.vi.2019, 3 spec. in a private garden, LMB obs.; Pest County, Budaörs env., Farkas-hegy, 47°28'27.29"N, 18°56'40.42"E, ca. 335 m a.s.l., 8.vi.2019, 1 spec., OMB obs.; 22.vi.2021, 1 ♂ FSLG after sunset, VSI obs.; Pest County, Törökbálint, Nagy-Mező, 47°25'31.01"N, 18°57'31.04"E, 216 m a.s.l., 18.vi.2019, 1 ♀ flying after sunset, VSI obs.; Budapest, Tétényi-fennsík env., 47°25'2.309"N 18°58'59.332"E, 180 m a.s.l., 6.viii.2021, 1 ♂, at light, MLB obs. + photo, DJP det.; Budapest, "Pest" [currently eastern part of Budapest], no other data, 2 spec in coll. MNHN; Újpest [currently part of Budapest], undated, 1 ♂, Robert

Meusel [leg.], coll. Jože Staudacher deposited in PMSL; Budapest, no other data, 7 spec. in coll. NHMW, 2 ♂♂ and 1 ♀ (ex original coll. Josef Breit, Vienna) in coll. Georg Frey deposited in NHMB, 1 ♂ (ex original coll. Josef Breit, Vienna) in coll. Jacques Baraud deposited in MNHN, 1 ♂ in coll. MNBG, 1 ♂ in coll. DKC; Budapest, undated, [Hugó] Diener [leg.], 2 ♂♂ and 1 ♀ (ex original coll. Josef Breit, Vienna) in coll. Georg Frey deposited in NHMB, 3 spec. in coll. ZSMG, 1 spec. in coll. SMNK, 1 ♂ in coll. DKC; Budapest, Ofen [= Buda], undated, [E.] Merkl [leg.], 2 ♂♂ and 2 ♀♀ (ex coll. Stöcklein) in coll. Georg Frey deposited in NHMB; “Buda-Pesth” [= Budapest], undated, 1 ♂ and 1 ♀, E. Merkl leg., coll. NMPC; Budapest, 1890, “coll. O. Leonhard”, no other data, 2 ♂♂ in coll. SDEI; Budapest, 1895, 1 ♂ and 1 ♀, [Hugó] Diener [leg.], coll. SDEI; Budapest, 1899, 2 ♀♀, [Hugó] Diener [leg.], coll. MSNG; Budapest, Hármashatárhegy Airfield, 47°33'11.133"N, 18°58'29.279"E, 276 m a.s.l., 7.vi.2019, 1 spec., NPB obs.; Pest County, Dunakeszi, gliding airport, 47°36'51.79"N, 19°8'55.91"E, 125 m a.s.l., 10.vi.2019, 1 ♀ flying after sunset, VSI obs.; Pest County, Bugyi env., Nemes-ürbő, ca. 47°10'55.9"N, 19°11'24.7"E, 92 m a.s.l., 7.vii.2018, 3 spec., Hunor Györfy obs.; Pest County, Bugyi, Ürbőpuszta, 47°9'52.47"N, 19°10'21.22"E, 91 m a.s.l., 10.vi.2019, 1 ♂ flying after sunset, VSI obs.; Pest County, Tatárszentgyörgy env., Ordító, ca. 47°2'13.8"N, 19°17'40.2"E, ca. 95 m a.s.l., 5.vii.1999, 4 spec., AMK obs.; Pest County, Tatárszentgyörgy env., Rohanka-dűlő, 47°3'48.05"N, 19°20'26.47"E, 98 m a.s.l., date not available [end of 20th or beginning of 21st century], 1 spec. flying after sunset, AMK obs.; Pest County, Tatárszentgyörgy env., Szabad-rét, ca. 47°3'14.07"N, 19°18'1.37"E, 94 m a.s.l., 29.vi.2018, 1 spec., CVK obs.; Pest County, Tatárszentgyörgy env., Széna-dűlő, ca. 47°1'42.25"N, 19°17'26.7"E, ca. 100 m a.s.l., 21.vi.1998, 3 ♀♀, AMK obs.; Pest County, Nagytarcsa env., Küdői-hegy hill, 47°32'21.43"N, 19°19'11.77"E, 230 m a.s.l., 8.vi.2003, 1 ♂ and 2 ♀♀, at light (mercury-vapor lamp), VSI obs. (1 spec. in coll. HNHM), 47°32'13.92"N, 19°19'10.72"E, 21.iv.2006, 1 ♀, at light (mercury-vapor lamp), VSI obs., 47°31'59.96"N, 19°19'22.96"E, ca. 250 m a.s.l., 19.vi.2018, 1 ♂, night sweeping, VSI leg., coll. HNHM, 1 ♀, at UV light, SIB obs., 47°32'17.59"N, 19°19'16.03"E, 18.vi.2013, 1 ♂ and 2 ♀♀, at light (mercury-vapor lamp), 25.vii.2019, 1 ♀, at UV light, VSI obs.; Pest County, Csomád, Öreg-hegy, 47°39'29.88"N, 19°12'38.05"E, 15.vi.2002, 1 ♂ and 1 ♀, at light (mercury-vapor lamp), VSI obs. (♂ in coll. HNHM); Pest County, Gödöllő, 55 Erdőszél Street, 47°36'11.3"N, 19°23'23.6"E, 250 m a.s.l., 15.vi.2004, 1 ♂, at light (mercury-vapor lamp), VSI leg., coll. HNHM, 5.viii.2004, 1 ♀, 7.viii.2004, 1 ♀, at light (mercury-vapor lamp), VSI obs.; Pest County, Gödöllő env., Faház-tető hill, 47°37'10.12"N, 19°25'8.94"E, 255 m a.s.l., 19.v.2004, 1 m and 2 ♀♀, at light (mercury-vapor lamp), VSI obs. (1 f in coll. HNHM), 47°37'5.81"N, 19°25'9.68"E, 26.vi.2017, 1 ♀, at light (mercury-vapor lamp), VSI, TNB and AKB obs.; Pest County, Gödöllő env., Perőc-oldal, 47°34'5.754"N, 19°20'8.424"E, ca. 250 m a.s.l., 30.vi.2019, 1 ♀, Csanád Szénási leg., coll. HNHM; Pest County, Váckisújfalu, Szélesek, 47°42'40.24"N, 19°19'36.32"E, 180 m a.s.l., 24.vii.2018, 1 ♀ flying after sunset, VSI obs.; Pest County, Pest County, Galgamácsa env., Ecskendi Forest, Ördög-árok area, 47°44'20.32"N, 19°25'17.34"E, 235 m a.s.l., 5.vi.2015, 1 ♀, at light (mercury-vapor lamp), VSI obs.; Pest County, Domonyvölgy, Bárányjárás, 47°37'23.8"N, 19°24'1.94"E, 220 m a.s.l., 21.v.2004, 1 ♂

and 1 ♀, at light (mercury-vapor lamp), VSI obs. (1 spec. in coll. HNHM); Pest County, Gödöllő - Máriabesnyő env., 47°35'38.59"N, 19°24'4.82"E, ca. 190 m a.s.l., 13.vi.2013, 1 ♂, ZKB obs. + photo (DJP det.); Pest County, Isaszeg, 29 Erdő Street, 47°31'23.412"N, 19°23'33.87"E, 19.vi.2003, 1 ♂, at light, VSI obs.; Pest County, Isaszeg env., Szarkaberkivölgy [valley] 47°32'14.86"N, 19°22'11.26"E, ca. 210 m a.s.l., 27.vi.2019, 2 ♂♂ and 1 ♀ flying after sunset, VSI obs., 1 ♂, at UV light, SIB leg., coll. HNHM; 23.vi.2020, 10 spec. SIB obs.; 1.vii.2020, 1 spec., at light, SIB obs.; Pest County, Isaszeg env., Kőmalmi tölgyes, 47°33'51.65"N, 19°25'48.93"E, ca. 250 m a.s.l., 9.v.2004, 1 ♀, at light (mercury-vapor lamp), VSI leg., coll. HNHM; Pest County, Dabas, 20.v.2012, 1 spec., at light, SIB obs.; Pest County, Pécel, 5.vi.2018, 1 spec., at light, SIB obs.; Pest County, Pécel env., 47°29'49.85"N, 19°22'56.56"E, ca. 200 m a.s.l., 12.vi.2010, 1 ♂, at light (mercury-vapor lamp), JDB obs.; Pest County, Pécel env., Trianoni-emlékmű, 47°28'28.86"N, 19°22'10.78"E, ca. 255 m a.s.l., 15.iv.2015, 1 spec., LNB obs.; Pest County, Csévharaszt, 24.vi.2004, 1 spec., at light, SIB obs.; Pest County, Albertirsa env., Golyófogó-völgy [valley], 47°15'52.86"N, 19°37'59.73"E, 150 m a.s.l., 1.vii.2019, 2 ♂♂ flying after sunset, SIB and VSI obs., 2 ♀♀, at UV light, SIB obs. (1 ♀ in coll. HNHM); Pest County, Tóalmás, Boldogkáta-puszta, 47°30'22.77"N, 19°42'2.44"E, 110 m a.s.l., 28.vi.2019, 1 ♂ and 1 ♀ flying after sunset, VSI obs. (♀ in coll. HNHM), 1 spec., at light, SIB obs.; Pest County, Tápióbicske, Gombai-patak [stream] bank, 47°22'12.5"N, 19°38'43.6"E, 120 m a.s.l., 3.vii.2019, 1 ♂ flying after sunset, VSI obs.; Pest County, Tápióbicske, Felső-Tápió [stream] bank, 47°23'58.92"N, 19°41'25.29"E, 111 m a.s.l., 20.vii.2020, 1 ♂ flying after sunset, VSI obs.

Southern Great Plain (Dél-Alföld), Bács-Kiskun County, Kunpeszér env., Alsó-Peszéri-rétek, ca. 47°3'50.129"N, 19°17'57.59"E, 93 m a.s.l., 8.vi.1996, 2 ♂♂, 23.vi.1998, 1 spec., 10.vi.2002, 2 ♂♂ and 1 ♀, at light, AMK obs.; Bács-Kiskun County, Kunpeszér env., Peszéri-erdő forest, ca. 100 m a.s.l., 6.vi.1998, 6 spec., 21.vi.1999, 3 spec., 30.vi.1999, 2 ♂♂, 11.vii.1999, 1 spec., AMK obs.; 26.vi.2018, 2 spec., at light, REE obs.; 28.vi.2018, 3 spec., at light, REE and CVK obs.; 4.vii.2018, 4 spec., 5.vii.2018, 7 spec., at light, REE obs.; 6.vii.2018, 1 spec., CVK obs.; 9.vii.2020, 1 spec., 13.vii.2020, 1 spec., at light, REE obs.; 22.vii.2020, 1 spec., 29.vii.2020, 1 spec., 30.vii.2020, 5 spec., 31.vii.2020, 2 spec., 8.viii.2020, 1 spec., 16.viii.2020, 10 spec., 18.viii.2020, 7 spec., 19.viii.2020, 6 spec., 20.viii.2020, 8 spec., Botond Kozma obs.; Bács-Kiskun County, Kunadacs env., Hungarian meadow viper Conservation Centre, ca. 47°1'27.807"N, 19°17'21.286"E, ca. 100 m a.s.l., 29.vi.2018, 1 spec., Vadász Csaba obs.; Bács-Kiskun County, Kunadacs env., Hetvenholdas, ca. 47°0'56.34"N, 19°16'54.34"E, ca. 97 m a.s.l., 27.ix.2016, 1 ♀ FSLG after sunset, AMK obs.; Bács-Kiskun County, Kunadacs, Nagy-erdő forest, date not available [21st century], 1 spec. caught after sunset, AMK obs.; Bács-Kiskun County, Kunadacs, Peregi-dűlő, ca. 46°57'0.4"N, 19°17'29.4"E, 95 m a.s.l., 6.vi.2006, 1 spec., AMK obs.; Bács-Kiskun County, Kunadacs env., Szabadszállási-legelő, ca. 46°56'6"N, 19°18'15"E, 94 m a.s.l., 9.vi.2006, 1 spec., AMK obs.; Bács-Kiskun County, Páhi, Páhi-rétek, ca. 100 m a.s.l., 10.vii.2020, 3 spec., CBK and REE obs.; Bács-Kiskun County, Kiskunhalas env., pasture, 46°24'10.97"N, 19°30'33.08"E, 122 m a.s.l., 7.vi.2021, 2 ♂♂ and 1 ♀, at light just after sunset, together with 1 ♀ of *Od. armiger*, TKK obs. + photo (DJP det.); Bács-

Kiskun County, Kecskemét – Hunyadiváros, 46°55'6.114"N, 19°42'43.794"E, 115 m a.s.l., 29.vi.2021, 1 ♀, at light, BCK and KVB obs. + photo (DJP det.).

Northern Hungary (Észak-Magyarország), Nógrád County, Kozárd, village area, 47°54'53.31"N, 19°37'7.07"E, 180 m a.s.l., 28.vii.2020, 1 ♀, at light (wall lamp of a residential house), KHE obs.; Nógrád County, Kozárd env., Majorsági-hegy hill, 47°54'59.87"N, 19°36'37.52"E, ca. 240 m a.s.l., 1.viii.2020, 1 ♀ flying after sunset, KHE obs.; Nógrád County, Kozárd env., Pohánka hill, 47°54'56.21"N, 19°37'29.88"E, 225 m a.s.l., 29.vii.2020, 1 ♂ and 1 ♀ flying after sunset, KHE obs.; Nógrád County, Bátonyterenye – Kisterenye, Váci Mihály Street, 48°0'32.22"N, 19°49'46.48"E, 190 m a.s.l., 28.v.1978, 1 ♂ FSLG after sunset, TKB and TKG obs.; Heves County, Tarnalelesz env., Pataji-far, 48°7'32.66"N, 20°9'32.12"E, 475 m a.s.l., 9.vi.2016, 1 ♂, in the grass during the day, shrubby edge of an oak forest (*Quercus cerris*), CBE obs.

Comment

Approximately one-third of the known localities of the species are located in Hungary. It is known here from 18 of the 19 counties. The first record from Hungary, without further details, is given by Illiger (1800). The first dated Hungarian record is from the vicinity of Buda (Graberl, a historical excursion destination) from 1798, only nine years after the species was described (Horváth 1884). Old records are summarised by Endrődi (1957). *Bolbelasmus unicornis* has been recorded several times as food for some birds (*Cuculus canorus*, *Falco vespertinus*, and *Upupa epops*) in several localities of the



Figure 12. Distribution of *B. unicornis* in Hungary (yellow circles – records before 1950, orange circles – records between 1950–1999, red circles – records after 1999).

Austro-Hungarian Empire, including two Hungarian, two Slovak, and one Romanian locality (Csiki 1904, 1905, 1910; Madon 1930; Keve and Szijj 1957). Newer Hungarian records are summarised by Nádain (2006). Data collected by Duna-Ipoly National Park are now available online (Duna-Ipoly National Park 2021). This study presents as yet unpublished records from 68 Hungarian localities. For the distribution of the species in Hungary see Fig. 12.

Slovenia

Published data

Carniola (Kranjsko), “Carniolia, *Bolboceras quadridens* Fabr.”, undated, 1 ♂, Ferdinand Joseph Schmidt leg., coll. F. J. Schmidt deposited in PMSL, Savo Brelih revid. (Brelih et al. 2010; sex supplemented by Tomi Trilar pers. comm., 2021); note: Trilar (2019) reported that there is another specimen of *B. unicornis* in the Schmidt’s collection in PMSL labelled “*Athyreus kordofanus*”, but the photograph makes it clear that it is a member of the genus *Athyreus*; Bohinjska Bela, 1 spec. with no other data in coll. JHIS (Brelih et al. 2010; Vrezec et al. 2011); Sorško polje, June 1900, 1 spec., Mate Hafner leg., coll. JHIS, Alja Pirnat revid. (Brelih et al. 2010; Vrezec et al. 2011).

Styria (Štajerska), “Leonhard” [= Lenart v Slovenskih goricah], no other data, 1 spec. J. N. Spitz leg. et coll. (Brancsik 1871; Horion 1958; Brelih et al. 2010; Vrezec et al. 2011); “Marburg, Styria” [= Styria, Maribor], undated, 2 ♂♂ and 1 ♀ [Josef] Peyer [leg.], coll. J. Peyer deposited in PMSL (Brelih et al. 2010; Vrezec et al. 2011; data supplemented and specified by Tomi Trilar pers. comm., 2021).

Comment

Although there are many localities suitable for the species in Slovenia, only five old records are known from this country. The species is most likely still present here, and the reason for the absence of new data is probably the low collecting activity of the local entomologists and/or the ignorance of appropriate monitoring methods for the species. Also, a recent attempt to rediscover the species in Slovenia (Pirnat 2009) was unsuccessful mainly due to the use of inappropriate collecting methods.

Croatia

Published data

Croatia proper (Središnja Hrvatska), Moslavina [a microregion between the rivers Lonja in the south and west, Česma in the north and Ilova in the east], no other data [19th century] (Schlosser Klekovski 1878); Koprivnica-Križevci County, Križevci env., no other data [19th century] (Schlosser Klekovski 1878).

Slavonia (Slavonija), Osijek-Baranja County, Osijek env., no other data [19th century], Vukas [leg.] (Schlosser Klekovski 1878); Vukovar-Syrmia

County, Vinkovci, promenade near the Bosut river, 80 m a.s.l., 1.vi.1895, 1 ♀, caught with a net, collector not specified (Koča 1906; Mikšić 1959, 1960, 1970); Vukovar-Syrmia County, Gradište env., 45°10'33.7"N, 18°44'54.7"E, mixed lowland forest, 81 m a.s.l., 5.vi.2014, 1 ♂, at light, collector not specified (Koren 2017).

Material examined

“Chorvatsko” [= Croatia in Czech language], 1 ♂, “ex. coll. E. Hachler”, no other data, coll. MMBC.

Dalmatia (Dalmacija), “Dalmatia”, no other data, 1 ♀ in coll NMPC; “Dalmat.” [= Dalmatia], no other data, 1 ♀ in coll. NMPC.

Comment

In Croatia, the species is known only from four old records from the 19th century. The only recent record (Gradište) is given by Koren (2017). Further historical undated specimens deposited in MMBC and NMPC are presented in this study.

Bosnia and Herzegovina

Published data

“Herzegovina”, no other data, 1 ♂ in coll. ZFMK (Hillert et al. 2016).

Federation of Bosnia and Herzegovina (Federacija Bosne i Hercegovine), Zavidovići env., Gostović river valley, no other data, Károly Kendi leg. (Kendi 1910); Sarajevo, no other data (Mikšić 1953, 1958, 1960, 1970; Lelo 2006; Lelo and Kašić-Lelo 2010; Koren 2017).

Federation of Bosnia and Herzegovina (Federacija Bosne i Hercegovine) or Republika Srpska (Република Српска), Babin potok [river], no other data, 1 spec. in coll. René Mikšić [currently deposited in CMZC] (Mikšić 1953, 1958, 1960, 1970; Lelo 2006; Lelo and Kašić-Lelo 2010; Koren 2017).

Comment

Only four old records from Bosnia and Herzegovina have been published. No recent findings are known.

Serbia

Published data

Vojvodina (Војводина), Srem District (Сремски округ), Mt. Fruška gora (Фрушка гора), village of Vrdnik (Врдник), June 2016, 1 ♀, at light, collector unknown, coll.

DKP deposited in NMPC (Ćurčić et al. 2019); Srem District (Сремски округ), Ruma (Рума), undated, 1 ♂, [Harald] Schweiger leg., coll. MSNG (Arnone and Massa 2010; Hillert et al. 2016; collector's name specified by Roberto Poggi pers. comm., 2021); Indija (Инђија) env., Krčedin (Крчедин), 1.vii.2013, 1 ♂, at light at 21.25 CEST, ZBB obs. + photo (Ćurčić et al. 2019; for more detailed data on this record see Material examined and new observations below); South Bačka District (Јужнобачки округ), South Bačka District (Јужнобачки округ), Mt. Fruška gora (Фрушка гора), Sremski Karlovci (Сремски Карловци) env., Stražilovo (Стражилово), 14.vii.2005, 1 ♀, at light, Dejan Stojanović obs. (Gavrilović and Stojanović 2008; Ćurčić et al. 2019); South Banat District (Јужнобанатски округ), Deliblato Sands (Делиблатска пешчара), Deliblato (Делиблато) env., Jagoda (Јагода), ca. 44°53'33"N, 21°3'2.6"E, date not specified, Zoran Gradojević leg. (Gradojević 1963; Ćurčić et al. 2019).

Belgrade District (Град Београд), Mala Ivanča (Мала Иванча) env., Grkovo (Грково), Trešnja Forest (Шума Трешња), 14.v.1986, 1 ♀ dug up beneath a hazel shrub together with *Tuber* fungi DPB leg. et coll. (Ćurčić et al. 2019); Mt. Kosmaj (планина Космај), Tresije Monastery (Манастир Тресије), 21.vi.2003, 1 ♀, dead under the lamp near a restaurant, DPB leg. et coll. (Ćurčić et al. 2019).

Southern and Eastern Serbia (Јужна и источна Србија), Bor District (Борски округ), Đerdap National Park (Национални парк Ђердап), 6 km WSW of Tekija (Текија), 27.–28.v.2014, 2 ♂♂ and 1 ♀, collector not specified, coll. DKP [deposited in NMPC] (Hillert et al. 2016; for details on this record see Material examined and new observations below); Pirot District (Пиротски округ), Bela Palanka (Бела Паланка) env., Babin Kal (Бабин Кал) env., 43°19'9"N, 22°23'23"E, 750 m a.s.l., 3.vii.2014, 1 ♂, at light, a meadow near an oak-hornbeam forest, SBS leg., coll. NMSB (Ćurčić et al. 2019); "Tsaribrod (Цариброд)" [= Dimitrovgrad (Димитровград)], no other data (Nedyalkov 1906; Mikšić 1959); Zaječar District (Зајечарски округ), village of Planinica (Планиница), 28.v.2006, 1 ♀, dug up in the garden, Siniša Ognjenović leg., coll. DPB (Ćurčić et al. 2019).

Material examined and new observations

Vojvodina (Војводина), Srem District (Сремски округ), Indija (Инђија) env., Krčedin (Крчедин), 19.viii.2006, 2 ♂♂, at light, steppe meadow near the Danube river, LMN leg., coll. RSG and VVO; 45°10'04.5"N, 20°08'15.4"E, 98 m a.s.l., 1.vii.2013, 1 ♂, at light at 21.25 CEST, ZBB obs. + photo (for partial data on this record see Ćurčić et al. 2019); South Bačka District (Јужнобачки округ), Fruška Gora National Park (Национални парк Фрушка гора), Bukovac (Буковац) env., northern slope of Beljevo (Белјево) hill, 45°10'56.579"N, 19°53'0.802"E, 270 m a.s.l., 27.v.2019, 1 ♂, dead on the ground near the road (killed in flight by a passing car), MSN obs. + photo (Fig. 14B).

Southern and Eastern Serbia (Јужна и источна Србија), Bor District (Борски округ), Leskovo (Лесково) env., 44°18'17.28"N, 21°56'54.96"E, ca. 400 m a.s.l., 20.vi.2020, 1 ♂ crawling on the ground near the road at 18.42 CEST, MPN obs. + photo (Fig. 14C); Bor District (Борски округ), Đerdap National Park (Национални

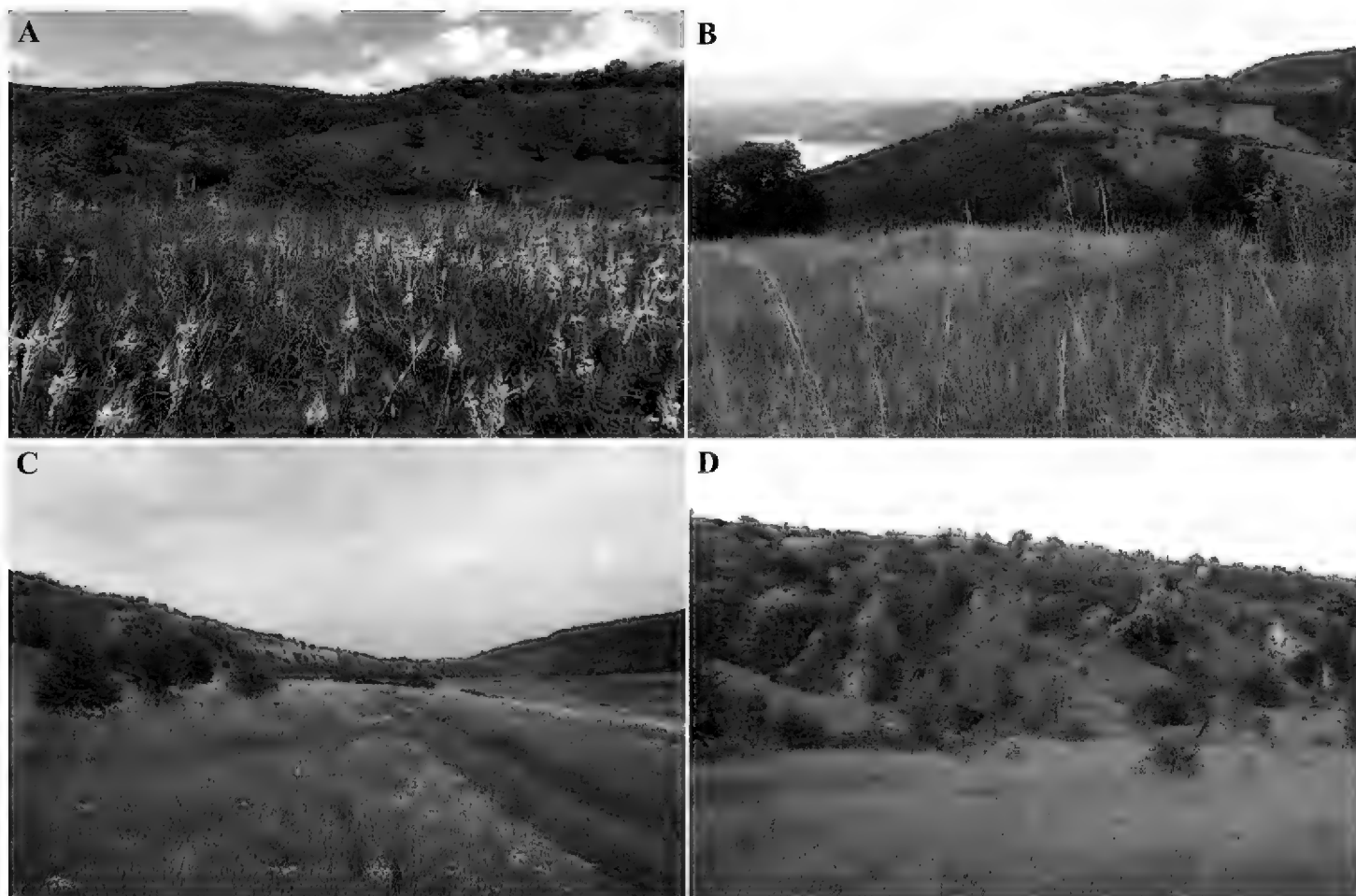


Figure 13. Localities with *B. unicornis* **A** Hungary, Kozárd env. (photograph by Krisztián Harnos) **B** Serbia, Đerdap National Park, Tekija env. (photograph by Ivo Martinů) **C, D** Ukraine, Dniester Canyon National Nature Park, Horodok env. (photographs by Yurii V. Kanarskyi).

парк Ђердап), 6 km WSW of Tekija (Текија), 44°39'19.4"N, 22°20'15.6"E, 300 m a.s.l., 27.v.2014, 1 spec. accidentally dug up while setting pitfall traps for ground beetles, RKP, 27.–28.v.2014, 51 spec. (both sexes in a ratio of 1:1) FSLG at 20.35–21.00 CEST, steppe hillside (probably former pasture, presently with tall vegetation) near an oak-beech forest, DHH (22 spec.), RKP (16 spec.), ZCP (11 spec.), TGK (1 spec.), and PSZ (1 spec.) leg., coll. OSD, DHH, DJP, DKP, GML, LMO, MBF, PSZ, RKP, TGK, VJP and ZCP (for incomplete data on this record see Hillert et al. 2016) (see Table 8 for full data on the flights); 12.–13.vii.2014, 8 ♂♂ and 12 ♀♀ FSLG at 20.43–21.15 CEST, the same place as May 27–28, RKP (11 spec.), IMO (7 spec.), MKJ (2 spec.) leg. et coll., 4 ♂♂ and 3 ♀♀ in coll. GML (see Table 8 for full data on the flights); 17.vi.2018, 1 ♂ and 2 ♀♀ FSLG after sunset, IMO, ZCP.

Comment

The known distribution of the species in Serbia was summarised by Ćurčić et al. (2019), who listed a total of 12 localities. New data from two of them (Krčedin, Tekija) and from two other new sites (Bukovac, Leskovo) are presented in this study.

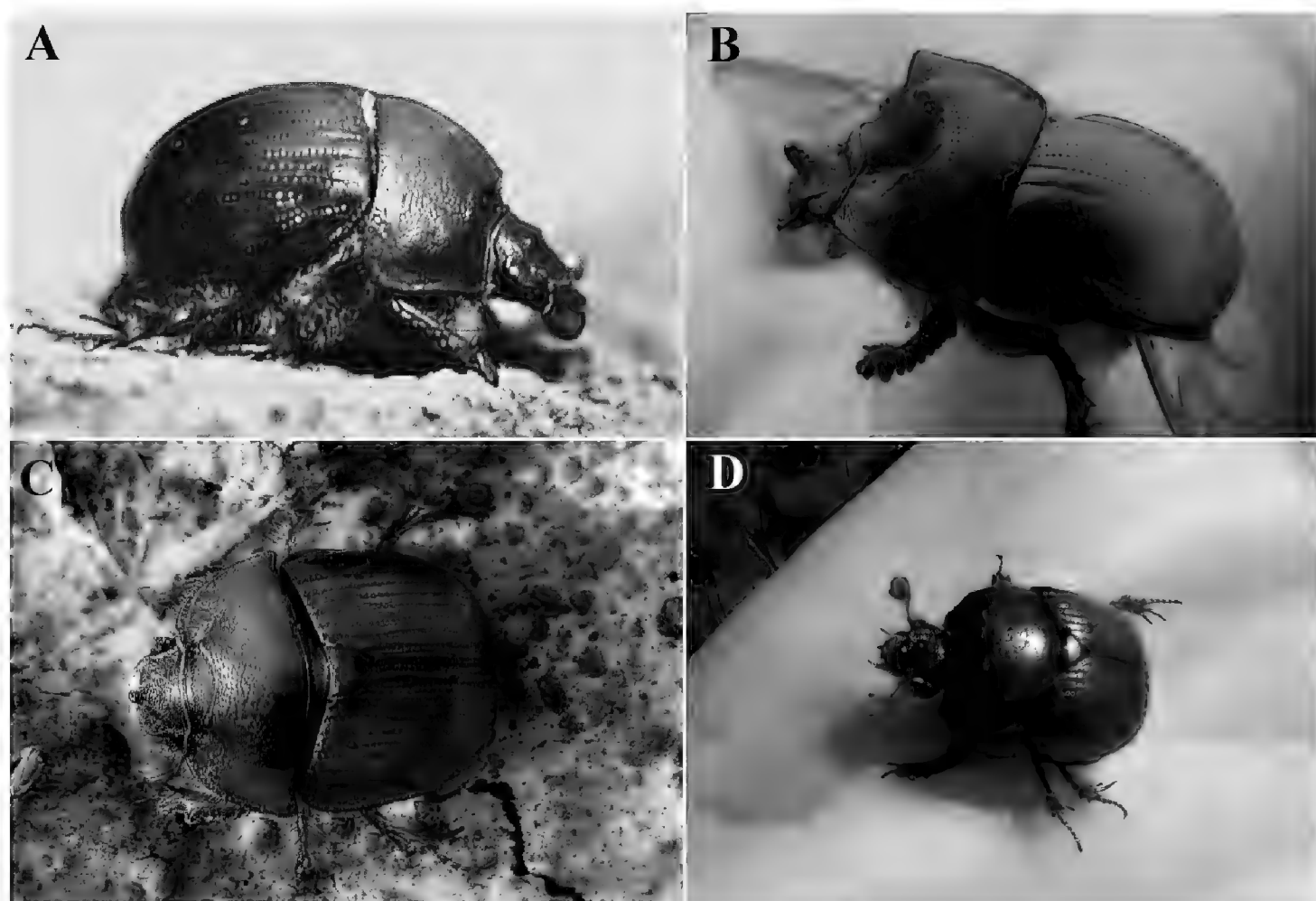


Figure 14. Findings of *B. unicornis* **A** Slovakia, Slanská Huta env., 24.vii.1972 (photograph by Zdeněk Laštůvka) **B** Serbia, Bukovac env., Beljevo hill, 27.v.2019 (photograph by Marko Šćiban) **C** Serbia, Leskovo env., 20.vi.2020, (photograph by Miloš Popović) **D** Ukraine, Semyhiria env., 3.vii.2020 (photograph by Dmytro Protopopov).

Albania

Published data

Tirana County (Qarku i Tiranës), Sauk, 10.vi.1958, 1 spec., 10.–20.vi.1961, 1 spec., Xhelo Murraj leg. (Murraj 1962); Ibë, 13.v.1959, 1 spec., 8.vi.1962, 1 spec., Xhelo Murraj leg. (Murraj 1962). Note: Murraj stated that he also found *Od. armiger* and *Och. integriceps* at both sites.

Comment

From Albania, only these records from two localities near Tirana have been published. Murraj (1962) reported that in Albania, *B. unicornis* is rare in lowland areas up to 700 m a.s.l. None of the editions of the Catalogue of Palaearctic Coleoptera (Kráľ et al. 2006; Nikolajev et al. 2016) lists Albania for this species.

Romania

Published data

Crişana, Arad County, “Újarad” [= Arad – Aradul Nou], 28.iv.1907, 1 spec. inside the digestive system of *Falco vespertinus*, Ernő Csiki obs. (Csiki 1910).

Transylvania (Transilvania), Sălaj County, Zaláu env., 3.viii.1973, 1 ♀, forest, collector unknown, coll. OHS (Hillert et al. 2016); Bistriţa-Năsăud County, “Bistritz” [= Bistriţa], no other data, Müller leg. (Petri 1912; Panin 1957); Bistriţa-Năsăud County, Urmeniş, no other data (Panin 1957); Hunedoara County, “Nagyág” [= Săcărâmb], no other data (Bielz 1887; Kuthy 1898; Petri 1912; Endrődi 1957; Panin 1957); Sibiu County, “Mediasch” [= Mediaş], no other data, Prof. Fabini leg. (Fuss 1858), no other data, Eduard Albert Bielz leg. (Bielz 1887; Kuthy 1898; Petri 1912; Endrődi 1957; Panin 1957); Sibiu County, “Nagyszeben” or “Hermannstadt” [= Sibiu], no other data (Kuthy 1898; Petri 1912; Endrődi 1957; Panin 1957); Sibiu County, “Szenterzsébet” [= Sibiu – Guşteriţa], no other data (Endrődi 1957); Cluj County, “Kolozsvár” [= Cluj-Napoca], no other data (Endrődi 1957); Cluj County, “Szamosújvár” [= Gherla], no other data, Ormay leg. (Kuthy 1898; Petri 1912; Endrődi 1957; Panin 1957); Cluj County, Stufărişurile de la Sic Nature Reserve env., 2002–2004, 6 spec., forest edge, no other data (Niţu 2007; Ruicănescu and Niţu 2008; Anonymus 2015); Mureş County, “Schässburg” [= Sighişoara or Segesvár], no other data, Karl Petri leg. (Petri 1912; Endrődi 1957; Panin 1957), Sighişoara, Târnava Mare river, no other data (Ruicănescu and Niţu 2008; Tatole et al. 2009).

Western Moldavia (Moldova Occidentală), Suceava County, “Mihoweny” [= Mihoveni], 1 ♂ with no other data (Jasilkowski 1906); Vaslui County, Zorleni, no other data (Fleck 1905; Panin 1957).

Banat, Caraş-Severin County, “Gerník” [= Gârnic] env., 44°45'36.72N, 21°46'29.48"E, 620 m a.s.l., 11.–13.vi.2016, ca. 14 spec. flying low above the ground after sunset, together with tens of spec. of *Od. armiger*, air temperature 12–15 °C, JHH, JPP, JSU MSZ, MPV and PIL obs. (Spružina 2016; data specified and corrected by JHH and JSU pers. comm., 2021).

Muntenia, Giurgiu County, Comana, no other data, Arnold Lucien Montandon leg., Jules Bourgeois det. (Montandon 1906); Bucureşti env., no other data (Manolache 1930).

Dobruja (Dobrogea), Tulcea County, Babadag [env.], [100–200 m a.s.l.], 1989–2000, no other data (Niţu 2001); Constanţa County, Albeşti env., Hagieni Forest, ca. 50 m a.s.l., no other data, L. Székely pers. comm., 2014 (Fusu et al. 2015).

Material examined and new observations

Transylvania (Transilvania), Sibiu County, “Transsylv. Alpen” [= Transsilvanische Alpen (Carpaţii Meridionali)], “R.Turm Paß” [= Roter-Turm-Pass (Pasul Turnu Roşu)], 350–450 m a.s.l., 1917, 1 ♂ and 1 ♀, Dr Maertens [leg.], coll. MNBG; Cluj County, Suatu, ca. 46°46'39"N, 23°58'24"E, ca. 365 m a.s.l., August 1997, 1 ♀, at light,

steppe hillside with sparsely scattered oak trees, ARC (for incomplete data on this record see Ruicănescu and Nițu 2008); Sibiu County, Șura Mare, [ca. 450 m a.s.l.], 28.vii.1972, 1 ♂ and 2 ♀♀, E[ckbert] Schneider [leg.], coll. Eckbert Schneider deposited in BNMS; Sibiu County, “Hammersdorf” [= Sibiu – Gușterița], [ca. 425 m a.s.l.], 17.vi.1888, [Mauritius von] Kimakowicz [leg.], coll. BNMS.

Western Moldavia (Moldova Occidentală), Bacău County, Comănești (ca. 46°25'38.5"N, 26°26'31.1"E), July 2004, 1 ♂, dead inside the collector's house (probably attracted by the light), APC; 31.vii.2010, 1 ♀, at light, APC; 8.viii.2011, 1 ♂, Barber pitfall trap, APC leg., coll. CMI; Iași County, Hârlău env., Pîrcovaci env., 47°28'28.29"N, 26°47'22.17"E, 240 m a.s.l., 24.vi.2021, 1 ♀, LHI obs. + photo (DJP det.); Iași County, Iași – Reditu, Iazul Tăutești, 47°13'33.4"N, 27°28'06.7"E, 120 m a.s.l., 28.vii.2021, 3 ♀♀, at light, MJR leg., coll. PKG; Iași County, Iași – Miroslava, Valea lui David, 47°11'38"N, 27°28'2.114"E, ca. 90 m a.s.l., 9.vii.2021, 2 ♀♀, together with 1 ♂ of *Od. armiger*, LHI obs. + photo (DJP det.); Iași County, Bârnova Forest (ca. 47°00'37.4"N, 27°33'32.8"E), 4.vii.2005, 1 ♂, found accidentally on the ground during the day, LFI leg., coll. CUIR (for incomplete data on this record see Ruicănescu and Nițu 2008; Tatole et al. 2009; Stan and Nițu 2013); Iași County, Stâncă near Comarna, 47°4'11.874"N, 27°48'13.403"E, 7.vii.2017, 1 ♂, at light, CMI.

Banat, Caraș-Severin County, Svatá Helena (Sfânta Elena) env., Kulhavá skála hill env., 44°42'11.47"N, 21°43'41.49"E, 357 m a.s.l., 1.vi.2012, 1 elytron on a path going through a pasture, BJN; Caraș-Severin County, Svatá Helena (Sfânta Elena), 44°40'29.8"N, 21°42'35"E, 325 m a.s.l., 18.vi.2017, 1 ♀ FSLG after sunset, ZCP, 44°40'57.73"N, 21°42'19"E, 350 m a.s.l., 23.vi.2017, 4 spec. FSLG after sunset, ZCP obs. (1 ♂ leg. et coll.); Caraș-Severin County, Mehadia, undated [19th century], 1 ♀, “ex. coll. [Otto] Staudinger”, coll. MTDG; Mehedinți County, Tisové Údolí (Eibenthal), ca. 44°32'36.7"N, 22°10'20.4"E, ca. 420 m a.s.l., 28.v.2008, 1 ♂ flying slowly up to 0.5 m above a path crossing a forest-steppe meadow at 21.45 EEST (= 40 min after sunset), JKV.

Muntenia, “Bukarest” [= Bucharest], undated, 1 ♂, V[ladimír] Zoufal leg., coll. Vladimír Zoufal deposited in MMBC; Teleorman County, Poroschia, [ca. 40 m a.s.l.], no other data, 1 ♀ in coll. GANM; Buzău County, Măgura, Mănăstirea Ciolanu [= Ciolanu Monastery], 5.vii.2014, 1 ♂, at light (160 W mercury-vapor lamp), beech forest, VUB.

Dobruja (Dobrogea), Tulcea County, Agighiol, 12.vi.1993, 1 ♀, Ioana Matache leg., coll. GANM; Tulcea County, Babadag [env.], [100–200 m a.s.l.], 20.vi.1958, 1 ♂, 20.vi.1968, 1 ♂, Nicolae Săvulescu leg., coll. GANM; 11.vii.1985, 1 ♂, at light (mercury-vapor lamp), foot of a forest-steppe loess hill, JHM leg., coll. VKS (for partial data on this record see Hillert et al. 2016); 16.v.2014, 2 ♀♀, Juhász leg., coll. GML; Tulcea County, Mănăstirea Codru [= Codru Monastery] env. (ca. 8 km S of Babadag), 44°48'55.47"N, 28°41'23.15"E, 110 m a.s.l., 6.vi.2016, 1 spec., IIB, 44°49'04.0"N, 28°40'57.9"E, 140 m a.s.l., 10.vi.2016, ca. 30 spec. FSLG after sunset, MVP obs. (1 ♂ leg., coll. NMPC); Constanța County, Băneasa – Canaraua Fetei, ca. 44°3'13.28"N, 27°40'15.07"E, ca. 115 m a.s.l., 17.vii.1965, 1 ♂, Nicolae Săvulescu leg., coll. GANM; Constanța County, Albești env., Hagieni Forest, ca. 50 m a.s.l.,

20.vi.1964, 1 ♀, collector unknown, coll. GANM; Constanța County, Hagieni, ca. 50 m a.s.l., 18.vi.1995, 1 ♀, at light, CWP leg., coll. LKKA.

Comment

For Romania, which can be considered one of the countries at the centre of the species' distribution, surprisingly small amounts of data have been published. New records from 22 Romanian localities are presented here.

Moldova

Published data

Călărași District (Raionul Călărași), Bularda near Dereneu, ca. 165 m a.s.l., 16.vi.1931, 3 ♂♂ and 4 ♀♀, Nicolai Zubowsky leg., coll. N. Zubowsky deposited in NMCM (Derjanschi et al. 2016; sex of the specimens specified by Valeriu Derjanschi pers. comm., 2021).

Ialoveni District (Raionul Ialoveni), Dănceni, ca. 170 m a.s.l., 31.v.1929, 1 ♂, Nicolai Zubowsky leg., coll. N. Zubowsky deposited in NMCM (Derjanschi et al. 2016; sex of the specimen specified by Valeriu Derjanschi pers. comm., 2021).

City of Chișinău (Municipiul Chișinău), Chișinău, [ca. 100 m a.s.l.], 20.v. and 10.vii.[between 1900–1915], no other data (Miller and Zubowsky 1917); 11.vii.1911, 1 ♀, Nicolai Zubowsky leg., coll. N. Zubowsky deposited in NMCM (Derjanschi et al. 2016; sex of the specimen specified by Valeriu Derjanschi pers. comm., 2021).

Material examined

City of Chișinău (Municipiul Chișinău), Chișinău, 20.iv.1912, 1 ♀, Nicolai Zubowsky leg., Valeriu Derjanschi det., coll. Rodion Stepanov (box No. 10) deposited in NMCM.

Anenii Noi District (Raionul Anenii Noi), Hîrbovăț env., Hîrbovăț Forest, ca. 285 m a.s.l., June 1970, 1 ♂, Rodion Stepanov leg., Valeriu Derjanschi det., coll. R. Stepanov (box No. 28) deposited in IZCM (for incomplete data on this record see Neculiseanu et al. 2002).

Comment

The first known record from Moldova (Chișinău) is mentioned by Miller and Zubowsky (1917). Old records from another two localities are reported by Derjanschi et al. (2016). The occurrence of the species in Moldova without further details is also mentioned by Panin (1957). This study presents the latest known Moldovan record from 1970.

Ukraine

Published data

“Gubernia podolska” [= Podolian Governorate (Подольская губерния) of the Russian Empire, now Ukraine] (Hildt 1892).

“Volhynien” [= Volhynian Governorate (Волинская губерния), a historical region of the Russian Empire that included almost the entire area of today’s Volyn Oblast, as well as the Rivne and Zhytomyr Oblasts, northern parts of the Ternopil and Khmelnytskyi Oblasts, parts of the Podlaskie and Lublin Voivodeships of Poland and Brest Region of Belarus], undated, 2 spec., prof. Bresser leg. (Hochhuth 1873; Tenenbaum 1923; Savchenko 1931) – this record probably refers to data from Kremenets (Ternopil Oblast) reported by Eichwald (1830) – see below.

? **Ivano-Frankivsk Oblast (Івано-Франківська область)**, Chornohora (Чорногора) [mountain range], 9.viii.1939, 1 ♂, collector unknown, coll. SIZK (Vasko 2010) – the nature of the area (high mountains) does not correspond to the known requirements of the species and its occurrence here is unlikely; it is therefore probably a mislabelled specimen.

Ternopil Oblast (Тернопільська область), Ternopil Raion (Тернопільський район), Zboriv (Зборів), 19.viii.1937, 1 ♀; collector unknown, coll. SIZK (Vasko 2010); Ternopil Raion (Тернопільський район), Ternopil (Тернопіль) env., “Gaje Tarnopolskie” [= Velyki Hai (Великі Гаї)], 26.vii.1884–1890, 1 spec., on a path, Michael Rybiński leg. et coll. (Rybiński 1897, 1903); Ternopil Raion (Тернопільський район), Ternopil (Тернопіль), no other data (Łomnicki 1913; Tenenbaum 1923; Savchenko 1938; Horion 1958); Ternopil Raion (Тернопільський район), “Zbaraż” [= Zbarazh (Збараж)] env., “Hnilice” [= Hnylytsi (Гнилиці)], no other data (Kuntze and Noskiewicz 1938); Kremenets Raion (Кременецький район), “Volhynia, Cremenezum” [= Kremenets (Кременець)] env., no other data (Eichwald 1830; Savchenko 1938).

Chernivtsi Oblast (Чернівецька область), Bukovina (Буковина), Chernivtsi Raion (Чернівецький район), Chernivtsi (Чернівці), 4 spec. with no other data (Horion 1958), 2 ♂♂ and 3 ♀♀ with no other data, coll. K. A. Penecke deposited in ZMNU (Vasko 2010), 1 ♀ in coll. NMPC (Hillert et al. 2016).

Vinnytsia Oblast (Вінницька область), Vinnytsia Raion (Вінницький район), Vinnytsia (Вінниця) env., August 1928, 1 ♂, caught in flight in the evening, collector unknown (Savchenko 1933, 1938); Vinnytsia Raion (Вінницький район), Vinnytsia (Вінниця) env., Sabariv meadows (Сабарівські луки), no other data, 1 ♂ in coll. Yevhen Mykolaiovych Savchenko deposited in NHMU (Vasko 2010); Vinnytsia Raion (Вінницький район), Lypovets (Липовець), 24.vi.1926, 1 ♂, collector unknown, coll. Ye. M. Savchenko deposited in NHMU (Savchenko 1934, 1938; Vasko 2010); Vinnytsia Raion (Вінницький район), “Lintsy (Лінці)” [= Illintsi (Іллінці)], [ca. 215 m a.s.l.], 10.v.1905, 1 ♂ and 1 ♀, collector unknown (Savchenko 1934,

1938), 14.vi. and 19.vi. (year not specified), no other data (Savchenko 1938); Haisyn Raion (Гайсинський район), Trostianets-Podilskyi (Тростянець-Подільський) [= Trostianets (Тростянець)] env., “Zatishje” [= village of Obodivka (Ободівка)], 15.vii.1930, 1 ♀, caught in flight in the evening, V. Paliy leg., coll. Ye. M. Savchenko deposited in NHMU (Savchenko 1933, 1938; Vasko 2010).

Odessa Oblast (Одеська область), Odessa Raion (Одеський район), Odessa (Одеса), 1827–1831, no other data (Krynicky 1832; Savchenko 1938; Trach and Gontarenko 2005), Odessa Raion (Одеський район), Odessa (Одеса) env., [1825–1860], 1 ♂, undated, [prof. I. B.] Bertoldi [leg.], “coll. University of Novorossiysk” (Kulikovskiy 1897; for information on Bertoldi’s collection see Sevastianov 2000, 2001), “2 spec. in coll. Gugel [or Hugel/Hügel]” (Kulikovskiy 1897); Odessa (Одеса) env., Bilhorod-Dnistrovskyi Raion (Білгород-Дністровський район), Sadove (Садове) env., Lymanyskyi (Лиманський) nature reserve, ca. 46°15'19.9"N, 30°11'2.9", ca. 50 m a.s.l., 8.vi.2004, 2 ♀♀, at UV light, HDO (Gontarenko and Trach 2011; data specified by YSK pers. comm., 2021); Rozdilna Raion (Роздільнянський район), 4 km NW of Butsynivka (Буцинівка) village, 4.vi.2011, 1 ♀, at UV light, YKO leg., coll. VTO (Gontarenko and Trach 2011; sex specified by YSK pers. comm., 2021).

Kyiv Oblast (Київська область), Kyiv (Київ), old town, May 1839, 4 spec. under a dead dog, June 1870, 1 spec. on a grassy path, Johann Heinrich Hochhuth leg. (Hochhuth 1873); Kyiv (Київ) env., no other data (Cherkunov 1889); Kyiv (Київ), undated, 1 spec., prof. Jelski leg., coll. of deceased J. Wańkowicz (Hildt 1896); Kyiv (Київ), Shevchenkivskyi Raion (Шевченківський район), Nyvky Park (Парк “Нивки”), 2.viii.1998, 1 ♂, dead on the ground, BVK leg., coll. SIZK (Vasko 2010); Kyiv (Київ), Holosiivskyi Raion (Голосіївський район), Holosiyiv Forest (Голосіївський ліс) [currently Holosiivskyi National Nature Park (Національний природний парк «Голосіївський»)], near the building of Astronomical Observatory of the National Academy of Sciences of Ukraine, 6.vi.1923, 1 ♀, Ye. M. Savchenko leg., coll. Ye. M. Savchenko deposited in NHMU (Savchenko 1934, 1938; Vasko 2010); Kyiv (Київ), Holosiivskyi Raion (Голосіївський район), Holosiyiv Forest (Голосіївський ліс) [currently Holosiivskyi National Nature Park (Національний природний парк «Голосіївський»)], 10.vii.1928, 1 ♀, Ye. M. Savchenko leg., coll. Ye. M. Savchenko deposited in NHMU (Savchenko 1934, 1938; Vasko 2010); Kyiv (Київ), Holosiivskyi Raion (Голосіївський район), Holosiivskyi National Nature Park (Національний природний парк «Голосіївський»), no other data (Solomakha et al. 2020); Kyiv (Київ), Holosiivskyi Raion (Голосіївський район), Lysa Hora (Лиса гора), 20.vi.1998, 1 ♀, pitfall trap, H. Uspenskyi leg., coll. BVK; 19.vi.2007, 1 ♀, pitfall trap, RHK leg., coll. SIZK (Vasko 2010; data specified by RHK pers. comm., 2021); Obukhiv Raion (Обухівський район), Hryhorivka (Григорівка), 6.vi.1928, 1 ♂, collector unknown, coll. Ye. M. Savchenko deposited in NHMU (Savchenko 1938; Vasko, 2010); Obukhiv Raion (Обухівський район), Rzhyschiv (Ржищів) env., area of the Ecological Research Centre “Hluboki Balyky (Глибокі балики)”, 49°57'44"N, 31°7'8"E, 5.–6.viii.2020, 1 spec., at light, VKK (Sheshurak et al 2020a); Bila

Tserkva Raion Raion (Білоцерківський район), village of Luka (Лука), undated [probably between 1925–1939, Bohdan M. Vasko pers. comm., 2020], 1 ♀, Jenni leg., coll. Ye. M. Savchenko deposited in NHMU (Vasko 2010).

Cherkasy Oblast (Черкаська область), Zvenyhorodka Raion (Звенигородський район), Talne (Тальне), 1 ♂ with no other data (Savchenko 1934, 1938); Cherkasy Raion (Черкаський район), Kaniv (Канів), hornbeam forest, 8.vi.1951, 1 ♀, collector not specified, coll. SIZK (Vasko, 2010); Cherkasy Raion (Черкаський район), Kaniv (Канів) env., Kaniv Nature Reserve (Канівський природний заповідник), no other data (Solomakha et al. 2020).

Chernihiv Oblast (Чернігівська область), Novhorod-Siverskyi Raion (Новгород-Сіверський район), Novhorod-Siverskyi (Новгород-Сіверський) env., 51°59'N, 33°16'E, 18.vii.2003, 1 spec., I. V. Porokhniach leg., coll. GUNU (Vovk et al. 2005, 2016; Sheshurak et al. 2018, 2020b).

Sumy Oblast (Сумська область), Shostka Raion (Шосткинський район), Matskove (Мацкове) env., ca. 51°28'48"N, 33°53'24"E, ca. 150 m a.s.l., 28.vii.2018, 1 spec., MZK (Kavurka et al. 2019).

Poltava Oblast (Полтавська область), Lubny Raion (Лубенський район), Lubny (Лубни), [ca. 160 m a.s.l.], July (year and number of specimens not specified), Kruhlik [leg.], coll. Provincial Museum of Poltava (Ohloblin 1913; Savchenko 1938).

Dnipropetrovsk Oblast (Дніпропетровська область), Synelnykove Raion (Синельниківський район), Raivka (Раївка), 1.viii.2000, 1 spec., A. M. Sumarokov leg. (Martynov 2003); Novomoskovsk Raion (Новомосковський район), Andriivka (Андріївка), 6.viii.1986, 1 spec., at light, A. M. Sumarokov leg. (Martynov 2003; Vasko and Bryhadyrenko 2011); Dnipro Raion (Дніпровський район), Dnipro (Дніпро) [Dnipropetrovsk until 19 May 2016], “около Днепропетровского Гослесхоза” [= near the Dnipropetrovsk State Forestry Enterprise, = Tunelna Balka (Тунельна балка) tract] (Vasko 2010; Vasko and Bryhadyrenko 2011; for detailed data see Material examined and new observations below); Dnipro Raion (Дніпровський район), Dnipro (Дніпро) [Dnipropetrovsk until 19 May 2016], 16.vi.2010, 1 ♀, collector not specified (Miessen 2011), 18.vi.2010, 1 ♀, Dementiev leg. (Brustel and Gouix 2012); Pavlohrad Raion (Павлоградський район), Kocherezhky (Кочережки) env., 21st century, no other data (Vasko and Bryhadyrenko 2011).

Material examined and new observations

Zakarpattia Oblast (Закарпатська область), Mukachevo Raion (Мукачівський район), “Schönb Ungarn” [= Hungary, Schenborn (Шенборн)], [ca. 190 m a.s.l.], “coll. Kirsch”, undated, 1 ♂, coll. MTDG.

Ivano-Frankivsk Oblast (Івано-Франківська область), Kosiv Raion (Косівський район), Pistyn (Пістинь), [ca. 400 m a.s.l.], undated, 1 ♂, “A. St?kl” [the third letter is illegible] leg., coll. SMLU.

Ternopil Oblast (Тернопільська область), Chortkiv Raion (Чортківський район), “Torskie, pow[iat] Zaleszcz[yki]” [= Zalishchyky (Заліщики) Powiat,

Torske (Торське)], [ca. 250 m a.s.l.], 27.vi.[19]33, 1 ♂, collector unknown, coll. MIZP; Dniester Canyon National Nature Park (Національний природний парк «Дністровський каньйон»), Chortkiv Raion (Чортківський район), Horodok (Городок), 48°38'18.96"N, 25°50'11.04"E, ca. 140 m a.s.l., 6.vii.2018, 6 ♂♂ and 2 ♀♀ FSLG after sunset, steppe meadow on the terrace of the Dniester (Дністер) river, YKL, YHS and ABZ leg. coll. YKL and YHS (for photographs of the site see Fig. 13C, D).

Chernivtsi Oblast (Чернівецька область), Bukovina (Буковина), Chernivtsi Raion (Чернівецький район), “Czernowitz” [= Chernivtsi (Чернівці)], no other data, 1 ♂ in coll. Georg Frey deposited in NHMB, 1 ♂ and 2 ♀♀ (ex original coll. Josef Breit, Vienna) in coll. Georg Frey deposited in NHMB, 2 ♂♂ and 3 ♀♀ in coll. ZMNU, 1 ♂ and 2 ♀♀ in coll. UMJG.

Vinnytsia Oblast (Вінницька область), “Киевская г[уберния], Сквирский у[езд]” [= Kiev Governorate of the Russian Empire (disestablished 1925), Skvirsky Uyezd (incorrectly, it was actually Lipovetsky Uyezd), currently Vinnytsia Raion (Вінницький район)], “Ильинцы” [= Illintsi (Іллінці)], 14.vi.[year not specified], [ca. 215 m a.s.l.], 1 ♀, collector not specified, coll. ZINR (probably one of the two specimens mentioned by Savchenko (1938) – see published data).

Odessa Oblast (Одеська область), Bilhorod-Dnistrovskyi Raion (Білгород-Дністровський район), Karolino-Buhaz (Кароліно-Бугаз), Studentska (Студентська) railway station, ca. 46°9'56.34"N, 30°33'24.58"E, 22 m a.s.l., 15.vi.2017, 1 ♂ crawling on the ground, OKO.

Kyiv Oblast (Київська область), Bila Tserkva Raion (Білоцерківський район), “Halaiki, Kijow[sk]a g[ubernia]” [= Kiev Governorate, Halaiky (Галайки)], [ca. 190 m a.s.l.], [probably 19th Century], no other data, 1 ♂ in coll. MIZP; Bucha Raion (Бучанський район), Muzychi (Музичі), ca. 160 m a.s.l., 18.vii.2006, 1 ♂, at light, M. Nesterov leg., coll. SIZK; “Kiew” [= Kyiv (Київ)], undated, 1 ♀ in Hartmann [leg.], coll. NMPC; “Kieff” [= Kyiv (Київ)], May [19]05, 1 ♂, Shelushko [leg.], coll. ZINR; Fastiv Raion (Фастівський район), Novosilky (Новосілки), ca. 180 m a.s.l., 21.vii.2012, 1 ♀, M. Nesterov leg., coll. SIZK; Obukhiv Raion (Обухівський район), Mali Dmytrovychi (Малі Дмитровичі), 50°12'59"N, 30°32'29"E, ca. 160 m a.s.l., 17.vii.2010, 1 ♂, at light, together with 1 ♂ of *Od. armiger*, VSK leg., coll. KLP; 29.v.2014, 1 ♂ and 1 ♀, at light, RHK; 25.v.2016, 1 ♂, 28.v.2016, 1 ♀, 13.vi.2020, 1 ♂ and 2 ♀♀, at light, STK; Obukhiv Raion (Обухівський район), Rzhyschiv (Ржищів), Taras Shevchenko Park (Парк імені Тараса Шевченка), 49°57'58.1"N, 31°02'39.5"E, 112 m a.s.l., 18.ix.2021, 1 ♀ crawling on the ground at 16:22 EEST, HTR obs. + photo (DJP det.); Obukhiv Raion (Обухівський район), Rzhyschiv (Ржищів) env., area of the Ecological Research Centre “Hlyboki Balyky (Глибокі балики)”, 49°57'44.082"N, 31°7'8.094"E, ca. 150 m a.s.l., 18.vi.2021, 1 ♀, at light OVK obs. + photo + recorded an audio track of its stridulation (DJP det.); 49°57'43.729"N, 31°7'9.782"E, 19.vi.2021, 1 ♂, together with 1 ♂ and 2 ♀♀ of *Od. armiger*, OVK obs. + photo (DJP det.); Myronivka Raion (Миронівський район), Tulyntsi (Тулинці), ca. 150 m a.s.l., 9.vi.2020, 1 ♀, at

light, STK; Myronivka Raion (Миронівський район), Velykyi Bukryn (Великий Букрин) env., 49°57'13"N, 31°18'8"E, 155 m a.s.l., 27.vi.2009, 1 ♀, at light, VSK.

Cherkasy Oblast (Черкаська область), Cherkasy Raion (Черкаський район), Kaniv (Канів) env., Kaniv Nature Reserve (Канівський природний заповідник), 49°43'12"N, 31°31'19"E, ca. 200 m a.s.l., 20.vi.1984, 6 spec. excavated from their burrows, steppe slope in a hornbeam forest, KVM and VGG leg., coll. MKY and MPGU.

Kirovohrad Oblast (Кіровоградська область), Oleksandriia Raion (Олександрійський район), Semyhiria (Семігір'я) env., 49°0'29.52"N, 32°54'21.24"E, 135 m a.s.l., 2.vii.2020, 1 ♂, at light, DPS obs. + photo (Fig. 14D).

Dnipropetrovsk Oblast (Дніпропетровська область), Dnipro Raion (Дніпровський район), Dnipro (Дніпро) [Dnipropetrovsk until 19 May 2016], Tunelna Balka tract (Тунельна балка) [the name of an area with oak forest in the southern part of the city, see Fig. 15], 48°25'11.8"N, 35°02'59.8"E, 15.vii.2005, 1 ♂ and 1 ♀ excavated from their burrows near the edge of a forest path under oak tree, OSD leg., coll. OSD and SIZK; 16.vi.2006, 3 ♂♂ and 4 ♀♀ excavated from their burrows, OSD leg., coll. SIZK; 16.vii.2006, 1 ♂ and 1 ♀ excavated from their burrows, OSD; 26.vii.2006, 1 ♂ excavated from its burrow near the edge of a forest path under oak tree, OSD; 20.–25.vii.2007, 1 ♂, OSD leg., coll. SIZK; 16.–17.vi.2008, 4 ♂♂ and 5 ♀♀ excavated from their burrows + at light, OSD leg., coll. SIZK; 18.vi.2008, 1 ♀, at light, OSD leg., coll. SIZK; 1.–10.vii.2008, 3 ♂♂ and 8 ♀♀ excavated from their burrows + at light, OSD leg., coll. SIZK (for partial data on these records see Vasko 2010); 3.vi.2013, 1 ♂ and 1 ♀ excavated from their burrows, OSD leg., coll. GML; 48°25'10.7"N, 35°02'54.5"E, June 2009, 3 ♀ excavated from its burrow near the edge of a forest path under oak tree, OSD leg., coll. OSD and GML; 16.vi.2010, 1 ♀, 8.vi.2010, 1 ♂, 18.vi.2010, 1 ♂ and 1 ♀, at light, OSD leg., coll. SIZK; 48°25'02.8"N, 35°02'26.6"E, 5.vii.2014, 1 ♂, at light, OSD leg., coll. SIZK; 8.–15.vi.2014, 13 spec. excavated from their burrows near the edge of a forest path under oak trees, OSD (1 ♀ in coll. DJP); 48°25'04.8"N, 35°02'40.6"E, 6.vi.2015, 1 ♂ excavated from its burrow under oak tree, OSD leg., coll. DJP; 16.vii.2015, 1 ♂, OSD leg., coll. NHMK; 48°25'12.8"N, 35°03'00.7"E, 8.vi.2010, 1 ♂ in flight, OSD; 18.vi.2010, 1 ♂ and 1 ♀, at light, OSD; 11.vi.2015, 1 ♀, at light at 21.40 EEST (= 61 min after sunset), OSD leg., coll. DKP deposited in NMPC; 48°24'57.3"N, 35°02'33.1"E, 1.vii.2015, 1 ♂ and 1 ♀ excavated from their burrows under oak tree (distance between these two burrows was 40 cm), OSD leg., coll. DJP; 48°25'00.0"N, 35°02'22.4"E, 7.vii.2015, 1 ♂, dead on a forest path, OSD leg., coll. DJP; 48°25'01.1"N, 35°02'23.6"E, 7.vii.2015, 1 ♀ excavated from its burrow under oak tree, OSD leg., coll. DJP; 48°24'57.1"N, 35°02'13.0"E, 9.–12.vii.2015, 1 ♂ and 1 ♀, pitfall traps, OSD leg., coll. DJP and DKP (deposited in NMPC); 48°25'02.1"N, 35°02'22.6"E, 8.vi.2016, 4 ♂♂ and 3 ♀♀ excavated from their burrows under oak trees, OSD leg., coll. DJP and GML; 48°25'0.70"N, 35° 2'22.30"E, 106 m a.s.l., 10.vi.2016, more spec. excavated from their burrows, OSD leg., 5 ♂♂ and 2 ♀♀ in coll. ASK, 1 ♂ and 2 ♀♀ in coll. VSM, 1 ♀ in coll. YSK; 48°24'55.9"N, 35°02'34.7"E, 16.–17.vi.2016, 2 ♂♂ excavated from their burrows under oak trees, together with 2 ♂♂ of *Od. armiger*, OSD leg., coll. DJP;

48°24'55.50"N, 35°2'33.20"E, 111 m a.s.l., 13.–25.vi.2020, 9 ♂♂ and 4 ♀♀, OSD leg., coll. ASK; 48°24'57.6"N, 35°02'29.4"E, 100 m a.s.l., 14.vii.2021, 1 ♂ excavated from its burrow, OSD leg., coll. DJP; 48°24'57.4"N, 35°02'30.7"E, 100 m a.s.l., 14.vii.2021, 2 ♂♂ excavated from its burrow, OSD leg., coll. DJP and GML; Dnipro Raion (Дніпровський район), “Опытное” (“Опытное”) [= Doslidne (Дослідне)], research area of the Institute of Grain Crops of NAAS of Ukraine (Інститут зернових культур НААН України), 48°22'58.2"N, 35°02'01.7"E, 143 m a.s.l., June 1978, remains of a dead specimen (elytra) on the ground near the greenhouse, OSD leg. et coll. (for partial data on this record see Vasko 2010; Vasko and Bryhadyrenko 2011).



Figure 15. Tunelna Balka tract (Ukraine), locality with abundant occurrence of *B. unicornis* **A–D** views of the site (photographs by Oleksandr O. Sukhenko) **E, F** burrows dug by adults of *B. unicornis* with push-ups (photographs by Oleksandr O. Sukhenko).

Comment

In the checklist of Ukraine (Martynov 2012), the species is listed from 12 of the 25 oblasts. The critical revision performed in the present study confirms occurrence in eleven of them with two additional ones: Sumy and Kirovohrad oblasts. Records from the Right Bank Ukraine are summarised by Vasko (2010). In the present study, new records from 15 Ukrainian localities are given, two of them (Schenborn and Semyhiria) being the first published records for the Zakarpattia and Kirovohrad oblasts, respectively.

Bulgaria

Published data

Vratsa Province (Област Враца), Oryahovo (Оряхово), no other data (Kovachev 1905).

Ruse Province (Област Русе), Vetovo (Ветово), no other data (Kovachev 1905).

Razgrad Province (Област Разград), Razgrad (Разград) env., 16.v.1905, in the barracks area, number of specimens not specified, Andrey Markovich leg, 13.vi.1907, in the vineyards, number of specimens not specified, Andrey Markovich leg. (Markovich 1909; Guéorguiev and Bunalski 2004).

Pleven Province (Област Плевен), Pleven (Плевен), April [year and collector not specified] (Nedyalkov 1909; Mikšić 1959; Guéorguiev and Bunalski 2004).

Sofia Province (Софийска област), Gorna Malina (Горна Малина) – “ДЗС” [= Държавно земеделско стопанство, area of the State Farm], ca. 650 m a.s.l., 7.vii.1969, 2 ♂♂ and 1 ♀ excavated from the soil from a depth of ca. 10 cm on a pasture (northern slope), collector not specified (Zaharieva-Stoilova 1974); Lozen Mountain (Лозенска планина), 5 km SE of German (Герман), “Germanski m.” [= German Monastery of St John of Rila (“Св. Иван Рилски”)], 31.v.[1]915, 1 ♂, Dr Iw[an Jossifow] Buresch [leg.], coll. NMSB (Guéorguiev and Bunalski 2004; data supplemented by Borislav Guéorguiev pers. comm., 2022; sex of the specimen corrected by the photograph).

Shumen Province (Област Шумен), Shumen (Шумен), ca. 200 m a.s.l., 1914, 2 ♂♂, Hanuš leg., coll. MYP (Král and Malý 1993).

Burgas Province (Област Бургас), “Michurin (Мичурин)” [= Tsarevo (Царево)], 29.–30.vi.1982, 1 ♂, at light., BSP (Král and Malý 1993).

Silistra Province (Област Силистра), Dulovo (Дулово) env., Karakuz forest (гора Каракуз) [note: the locality label states “Gora Kanagöl, Dulowsko”], 14.vi.1952, 1 ♀, P[encho Stefanov] Drenski leg., coll. NMSB (Guéorguiev and Bunalski 2004; data specified by Borislav Guéorguiev, 2022).

Material examined and new observations

Vidin Province (Област Видин), Dimovo (ДИМОВО) env., steppe meadow near the Archar (Арчар) river, 43°45'28.7"N, 22°44'51.1"E, 110 m a.s.l., 26.vi.2010, 3 ♂♂

and 2 ♀♀ FSLG after sunset just before a storm, together with several spec. of *Och. chrysomeloides*, no wind, 26 °C, ASH (Fig. 10C, D).

Varna Province (Област Варна), Oreshak (Орешак) env., 43°17'50.67"N, 27°53'47.29"E, 300 m a.s.l., 6.vii.2020, 1 ♀ flying up to 0.5 m above the grass at ca. 22.00 EEST, forest-steppe clearing in an oak forest, MTM obs. + photo (Fig. 10E, F).

Comment

So far, only nine localities have been published for Bulgaria. This study presents new records from two additional sites.

Turkey (European part)

Published data

Marmara Region (Marmara Bölgesi), Edirne Province, ca. 15 km E of Edirne [according to Walter Heinz, pers. comm., these were periodically flooded meadows on the banks of the Ebro River S of Edirne], 27.iii.[19]88, 1 ♀, WHS leg., coll. DKP deposited in NMPC (Hillert et al. 2016).

Turkey (Asian part)

Published data

Aegean Region (Ege Bölgesi), Denizli Province, Denizli env., [Çürüksu River valley], “Goundely” [= Goncalı] [railway station env.], ca. 200 m a.s.l., May [19]26, 1 ♂, [Hans] Kulzer leg., coll. ZSMG (Hillert et al. 2016; locality identified by the author, year corrected by Oliver Hillert pers. comm., 2021) – see Fig. 16A.

Material examined

Aegean Region (Ege Bölgesi), Aydın Province, [Büyük Menderes River valley], “Bereketli (Denizli)” [= Bereketli near Nazilli], ca. 80 m a.s.l., 5.vii.1965, 1 ♂, [Helio] Pierotti and [Antonello] Perissinotto leg., DJP det. (2021), coll. Helio Pierotti deposited in MSNG – this record was published under a misidentification as *Bolbelasmus tauricus* Petrovitz, 1973 (Arnone and Massa 2010) – see Fig. 16B.

Comment

Only the three records mentioned above are known for Turkey. A record from Osmaniye Province (Kadirli) reported by Lodos et al. (1999) most likely refers to the related species *Bolbelasmus nireus* (Reitter, 1895) (see Miessen 2011; Hillert et al. 2016; Sommer et al. 2021).

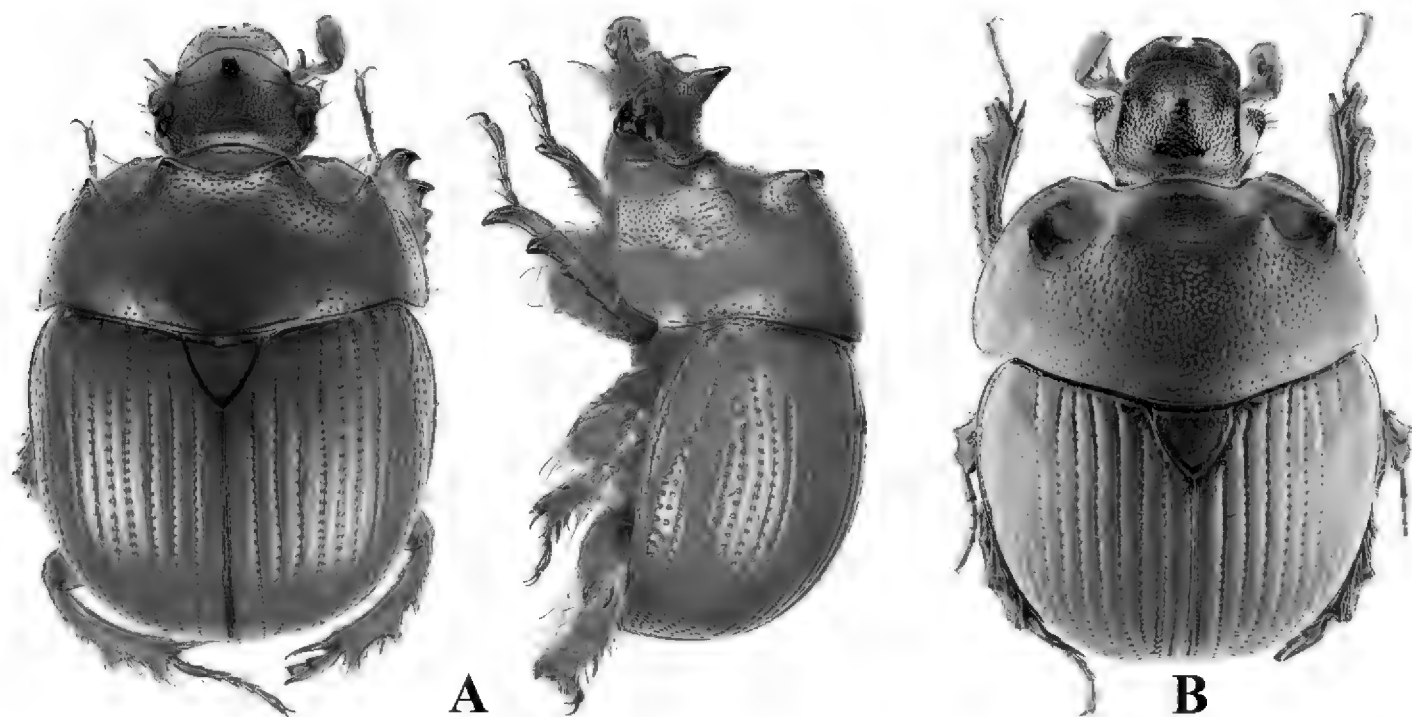


Figure 16. The only two specimens of *B. unicornis* so far known from Asia **A** Turkey, Denizli env., [Çürüksu River valley], “Goundely” [= Goncalı] [railway station env.], May [19]26, [Hans] Kulzer leg., coll. ZSMG, dorsal and lateral views, body length 12.0 mm (photographs by Michael Balke) **B** Turkey, [Büyük Menderes River valley], “Bereketli (Denizli)” [= Bereketli near Nazilli], 5.vii.1965, [Helio] Pierotti & [Antonello] Perissinotto leg., coll. MSNG, body length 12.5 mm (photograph by Marcello Romano).

Dubious faunistic records

Great Britain

Published data

East of England, Cambridgeshire, marshes between Peterborough and Wisbech, beginning of summer 1807, 1 ♂ and 1 ♀, plant materials alluviated by flooded River Nene, together with 2 ♂♂ and 3 ♀♀ of *Od. armiger*, William Skrimshire leg. (Skrimshire 1812; Curtis 1829a, b; Stephens 1829, 1830, 1839).

Comment

Skrimshire’s record was probably adopted by several subsequent authors (e.g., Mulsant and Rey 1871; Sajó 1910b; Boucomont 1912; Paulian 1941; Tesař 1957; Neculiseanu et al. 2002; Trnka 2009; Vasko 2009; Arnone and Massa 2010; Vasko and Bryhadyrenko 2011; Vidlička 2011). According to Darren Mann (pers. comm. 2021), it is based on a misidentified *Od. armiger*, with no material from the British Isles. Also, Paulian and Baraud (1982) considered the report from England to be erroneous without giving any explanation. *Bolbelasmus unicornis* was no longer listed for Great Britain by the following authors: Fowler (1890), Joy (1932), Britton (1956), Jessop (1986), Mann (2012), and Lane and Mann (2016). Even in both editions of the Catalogue of

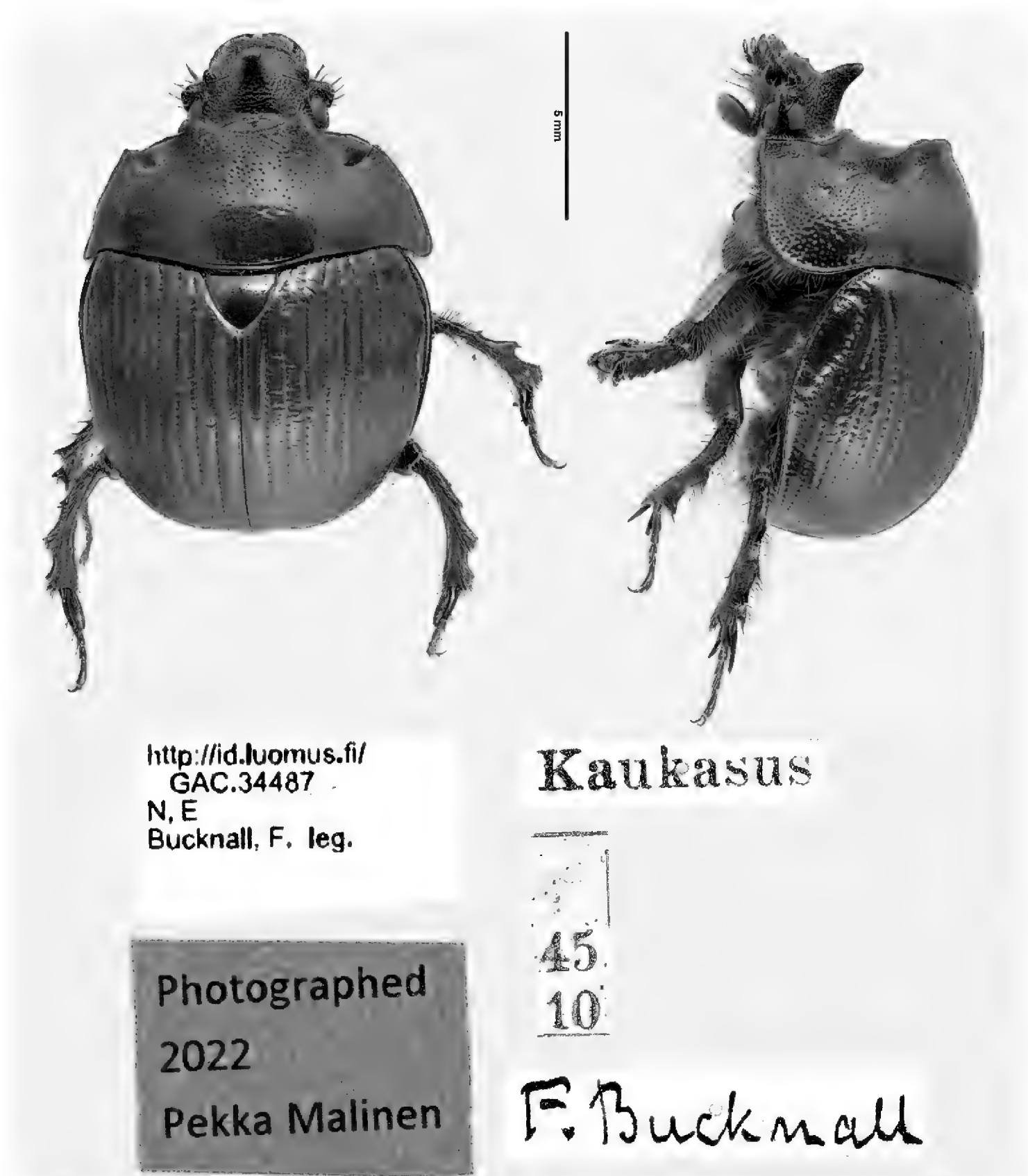


Figure 17. The only specimen of *B. unicornis* that could originate from the Caucasus region, deposited in FMNH (photographs by Pekka Malinen, edited by Peter Kurina).

Palearctic Coleoptera (Král et al. 2006; Nikolajev et al. 2016), the United Kingdom is not listed as a country of occurrence of this species.

Country not specified [probably Russia]

Material examined

“Kaukasus” [= Caucasus], locality and date not specified, 1 ♂, F. Bucknall [leg.], coll. FMNH (Fig. 17).

Comment

This specimen represents the first record of the species from the Caucasus region. Unfortunately, country is not specified (it could be Russian part of the area, but confusion of the locality label cannot be discounted). Shokhin (2007) did not record the species from Southern Russia.

Remarks on distribution

Bolbelasmus unicornis was included in checklists, catalogues, and monographs dealing with the scarabaeoid fauna of several countries as follows: France (Montreuil 2014), Germany (Köhler and Klausnitzer 1998; Bleich et al. 2022), Italy (Ballerio et al. 2014; Carpaneto et al. 2021), Poland (Burakowski et al. 1983), Czech Republic and Slovakia (Juřena and Týr 2008; Zahradník 2017), Austria (Jäch et al. 1994), Hungary (Ádám 1994), Slovenia (Brelj et al. 2010), Bosnia and Herzegovina (Lelo 2006), former Yugoslavia (Mikšić 1970), Albania (Murray 1962), Romania (Chimişliu 2004), Republic of Moldova (Bacal et al. 2013), Ukraine (Martynov 2012), Bulgaria (Bunalski 2001), and Turkey (Carpaneto et al. 2000). Also, it was mentioned in two editions of the Catalogue of Palearctic Coleoptera (Král et al. 2006; Nikolajev et al. 2016). For the general distribution of the species see Fig. 18.

No records are known from mainland Greece. Records from the Greek island of Crete (Heyden 1884; Oertzen 1886; Mikšić 1959; Neculiseanu et al. 2002; Trnka 2009) refer to species later described as *Bolbelasmus keithi* Miessen and Trichas 2011 (see Miessen and Trichas 2011; Hillert et al. 2016), and the records from Rhodes (Schatzmayer 1936; Paulian 1941, 1959; Tesař 1957; Mikšić 1959; Petrovitz 1959; Paulian and Baraud 1982; Petersen et al. 2006) most likely relate to *B. nireus* (see Sommer et al. 2021). The record from Greece reported by Reitter (1892) probably refers to Crete, and thus to *B. keithi*. Also, all subsequent records from Greece (Paulian 1941, 1959; Krikken 1977; Lumaret 1990; Neculiseanu et al. 2002; Szwajko 2004; Agoglitta et al. 2006; Král 2006; Král et al. 2006; Vasko 2009; Vasko and Bryhadyrenko 2011; Vidlička 2011; Brustel and Gouix 2012; Alonso-Zarazaga et al. 2013; Gutowski and Przewoźny 2013; Trizzino et al. 2013; Potocký and Majzlan 2015; Nikolajev et al. 2016; Ćurčić et al. 2019; Schoolmeesters 2019; Nuß and Jäger 2020) most likely refer to the Greek islands and thus to *B. keithi* or *B. nireus*.

Records from Cyprus (Keith 2002; Král 2006; Alonso-Zarazaga et al. 2013; Potocký and Majzlan 2015; Schoolmeesters 2019; Nuß and Jäger 2020) refer to species described as *Bolbelasmus makrisi* Miessen, 2011 (see Miessen 2011; Hillert et al. 2016; Sommer et al. 2021).

All the records from the Soviet Union and Russia (e.g., Medvedev 1965; Baraud 1992; Agoglitta et al. 2006; Král et al. 2006; Brelj et al. 2010; Brustel and Gouix 2012; Ballerio et al. 2014; Merkl 2014; Hillert et al. 2016; Ćurčić et al. 2019; Schoolmeesters 2019) apply to Ukraine (Andrey V. Frolov and Liliya A. Akhmetova pers. comm.,

2020). In the second edition of the Catalogue of Palaearctic Coleoptera (Nikolajev et al. 2016), Russia is no longer listed as a country of occurrence of this species.

The species has also been listed for Belarus, Montenegro, and the Republic of North Macedonia (Chobot and Mourek 2008; Alonso-Zarazaga et al. 2013; Potocký and Majzlan 2015; Nuß and Jäger 2020), but there are no exact data from these countries, although its occurrence at least in Montenegro and North Macedonia is highly probable. Other countries where the species is highly likely to occur are Kosovo, mainland Greece (especially Macedonia and Thrace), and western Russia (e.g., Bryansk, Kursk, Belgorod and Rostov oblasts, and Krasnodar Krai). Occurrence in southern Belarus cannot be ruled out either. The species is most likely extinct in France, Switzerland, Poland, and the Czech Republic (considering the lack of suitable habitats and any new records).

Figure 18 probably does not reflect the real distribution of *B. unicornis* because of insufficient surveys in some countries. In countries such as Serbia, Romania, Moldova, Ukraine, and Bulgaria, there are probably many localities with *B. unicornis* that have not yet been discovered due to low collecting activity and the lack of application of effective collecting methods for this beetle species (see Monitoring methods below).

The northernmost known historical locality of *B. unicornis* is Warsaw (Poland), while the northernmost locality with a recent record is Novhorod Siverskyi (northern



Figure 18. Distribution of *B. unicornis* (yellow circles – records before 1950, orange circles – records between 1950–1999, red circles – records after 1999).

Ukraine). The southernmost historical locality is Denizli (southwestern Turkey), while the southernmost recent localities are Babin Kal (Serbia) and Oreshak (Bulgaria). The westernmost historical locality is Mulhouse (Alsace, France), while the westernmost recent localities are Bruchsal (Baden, Germany) and Lerma (Piedmont, Italy). The easternmost locality with a recent record of the species is Kocherezhky (Ukraine), which is also the easternmost known point of occurrence of the species.

Natural history of Bolboceratinae

Evening flights of *B. unicornis*

Adults of *B. unicornis* spend most of their time underground. Above-ground activity is limited to short flight periods after sunset. Exceptionally, adults have been observed crawling on the ground during daylight hours (see Faunistic records). Flight statistics from each site are shown in Tables 1–8. A total of 63 periods of flights was documented at eight localities. The flights occurred in the date range from 27 May to 9 September with a total of 884 flying individuals observed. Both males and females flew, with slightly fewer females (ca. 44%). By comparison, in the congener *B. gallicus*, only 5% of the 830 individuals found were females (Rahola Fabra 2004) but in that study, these were mostly beetles excavated from their burrows. The flights of adults of *B. unicornis* started, on average, 35 minutes after sunset and terminated 60 minutes after sunset. For the start of flights, the minimum limit recorded was 23 minutes after sunset, and the maximum limit was 52 minutes after sunset. For the end of flights, the minimum and maximum limits were 35 and 86 minutes after sunset, respectively. On one occasion, a large number of specimens were observed flying around midnight (Josef Pavlas pers. obs., see Faunistic records). The average duration of flights was of 25 minutes, with the minimum and maximum limits of 4 and 63 minutes, respectively. The average air temperature during flights was 21 °C with limits of 14 and 26 °C. However, it is likely that the beetles are able to fly at lower temperatures, as has been observed, for example, in the Australian bolboceratine *Blackburnium insigne* (Lea, 1916), adults of which have been found flying to lights at 4–6 °C (Howden et al. 2007). Flights of *B. unicornis* occurred exclusively after heavy rains when the soil was moist to a depth of at least ca. 30 cm. The flights were also affected by the wind intensity. Most of the flying adults were observed when there was no wind, whereas flights did not occur at all when the wind was strong. Light rain or heavy fog had no effect on the flying beetles, and, in one case, the beetles were found flying even with moderate rain (Filip Štrba pers. comm.). Similarly, flights of adults of *Odonteus armiger* were observed during rain (Ivo Jeniš and Ilja Trojan pers. comm.). Adults of *B. unicornis* usually fly very slowly at a height of 20–50 cm above the ground, sometimes literally hovering in the same spot. However, in windy conditions they have been observed to fly faster and also at greater heights, ca. 1–2 m above the ground. Individuals flying quickly around a pile of logs at the edge of a forest were observed by the author near the village of Hajnáčka

Table 1. Data on flights of adults of *B. unicornis* at the locality of PP Panský diel. Key: BF = beginning of flights, EF = end of flights, S = sunset, S-BF = time period from sunset to the beginning of flights, S-EF = time period from sunset to the end of flights, DF = duration of flights, T = air temperature during flights.

Slovakia, Bratislava – Podunajské Biskupice, Kopáč Island, PP Panský diel									
date	n (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
7.vi.2016	11 (6/5)	21.25	21.45	20.47	38 min	58 min	20 min	14 °C	heavy dew, no wind
8.vi.2016	4 (4/-)	21.27	21.43	20.48	39 min	55 min	16 min	16 °C	dew, no wind
18.vi.2016	6 (3/3)	21.33	21.53	20.54	39 min	59 min	20 min	19 °C	dew, no wind
21.vi.2016	5 (3/2)	21.31	22.03	20.54	37 min	69 min	32 min	21 °C	no wind
22.vi.2016	6 (2/4)	21.21	21.57	20.55	26 min	62 min	36 min	22 °C	no wind
23.vi.2016	11 (6/5)	21.33	21.53	20.55	38 min	58 min	20 min	23 °C	no wind
24.vi.2016	24 (10/14)	21.36	22.08	20.55	41 min	73 min	32 min	25 °C	no wind
25.vi.2016	7 (2/5)	21.28	22.08	20.55	33 min	68 min	32 min	26 °C	no wind
26.vi.2016	25 (13/12)	21.31	22.09	20.55	36 min	74 min	38 min	20 °C	light breeze
27.vi.2016	10 (2/8)	21.31	21.57	20.55	36 min	62 min	26 min	20 °C	gentle breeze
28.vi.2016	9 (2/7)	21.28	21.48	20.55	33 min	53 min	20 min	19 °C	light breeze
29.vi.2016	14 (8/6)	21.29	22.03	20.55	34 min	68 min	34 min	24 °C	light dew, no wind
21.vii.2016	36 (25/11)	21.09	21.51	20.41	28 min	70 min	42 min	24 °C	no wind
22.vii.2016	51 (28/23)	21.08	21.51	20.40	28 min	71 min	43 min	23 °C	ground mist, no wind
23.vii.2016	41 (26/15)	21.09	21.53	20.39	30 min	74 min	44 min	24 °C	light ground fog, no wind
24.vii.2016	68 (38/30)	21.08	21.49	20.38	30 min	71 min	41 min	23 °C	dew, no wind
25.vii.2016	15 (14/1)	21.06	21.41	20.37	29 min	64 min	35 min	22 °C	light rain, no wind
29.vii.2016	13 (10/3)	21.02	21.30	20.32	30 min	58 min	28 min	22 °C	light dew, no wind
30.vii.2016	37 (16/21)	20.53	21.56	20.30	23 min	86 min	63 min	24 °C	light dew, no wind
7.viii.2016	29 (16/13)	20.46	21.16	20.19	27 min	57 min	30 min	17 °C	no wind
8.viii.2016	46 (26/20)	20.45	21.25	20.17	28 min	68 min	40 min	16 °C	no wind
13.viii.2016	51 (32/19)	20.40	21.01	20.09	31 min	52 min	21 min	19 °C	no wind
n (♂/♀)	519 (292/227)		average		32 min	65 min	32 min	21 °C	

Table 2. Data on flights of adults of *B. unicornis* at the locality of PR Ostrovné lúčky (for abbreviations see Table 1).

Slovakia, Bratislava – Čunovo, PR Ostrovné lúčky									
date	n (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
25.vii.2016	10 (6/4)	21.10	21.37	20.37	33 min	60 min	27 min	24 °C	before rain, no wind
29.vii.2016	3 (2/1)	21.11	21.25	20.31	42 min	56 min	14 min	22 °C	no wind
n	13 (8/5)		average		38 min	58 min	21 min	23 °C	

Table 3. Data on flights of adults of *B. unicornis* at the locality of Kalinkovská lesostep (for abbreviations see Table 1).

Slovakia, Kalinkovo, Kalinkovská lesostep									
date	n (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
27.vii.2016	3 (1/2)	21.04	21.15	20.34	30 min	41 min	11 min	22 °C	no wind

in southern Slovakia (see Faunistic records). This phenomenon was also observed in *Od. armiger* (Ilja Trojan and Ivo Jeniš pers. comm.): adults of this species were flying around the fallen oak trunk and piles of wet logs after sunset. When disturbed, the flying specimens of *B. unicornis* either immediately fell into the grass and buried themselves or accelerated their flight, increasing the height from the ground and flying

Table 4. Data on flights of adults of *B. unicornis* at the locality of Čierná hora hill (for abbreviations see Table 1).

Slovakia, Kamenica nad Hronom env., Čierna hora hill									
date	n (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
6.vi.2010	5 (4/1)	21.30	21.45	20.38	52 min	67 min	15 min	-	after the floods
7.vi.2010	16 (10/6)	21.23	21.55	20.39	44 min	76 min	32 min	-	-
4.viii.2011	17	20.50	21.20	20.18	32 min	62 min	30 min	18 °C	after ca. 10 days of persistent rainfall, ca. 2 hours after the rain has ceased, vegetation heavily soaked, no wind
5.viii.2011	10	20.50	21.10	20.16	34 min	54 min	20 min	20 °C	almost no wind
6.viii.2011	8	20.40	21.00	20.15	25 min	45 min	20 min	23 °C	almost no wind
9.viii.2011	15	20.45	21.05	20.10	35 min	55 min	20 min	17 °C	almost no wind
11.viii.2011	14	20.40	21.05	20.07	33 min	58 min	25 min	18 °C	almost no wind
12.viii.2011	9	20.40	21.05	20.05	35 min	60 min	25 min	18 °C	almost no wind
13.viii.2011	16	20.30	21.05	20.03	27 min	62 min	35 min	19 °C	almost no wind
16.viii.2011	2 (1/1)	20.35	21.05	19.58	37 min	67 min	30 min	22 °C	dry, almost no wind
7.vi.2013	22 (13/9)	21.20	21.45	20.39	41 min	66 min	25 min	18 °C	almost no wind
8.vi.2013	15 (10/5)	21.17	21.42	20.40	37 min	62 min	25 min	20 °C	light air to light breeze
12.vi.2013	15	21.20	21.35	20.43	37 min	52 min	15 min	18 °C	soil heavily saturated with water after rain, soaked vegetation
15.vi.2013	10	21.20	21.45	20.44	36 min	61 min	25 min	-	-
3.ix.2014	8 (5/3)	19.52	20.07	19.24	28 min	43 min	15 min	20 °C	light air to gentle breeze
4.ix.2014	13 (8/5)	19.51	20.16	19.22	29 min	54 min	25 min	22 °C	almost no wind
5.ix.2014	4 (2/2)	19.47	20.04	19.20	27 min	44 min	17 min	23 °C	almost no wind
9.ix.2014	2 (2/-)	19.43	19.47	19.12	31 min	35 min	4 min	22 °C	almost no wind
5.vi.2015	2 (2/-)	21.22	21.27	20.38	44 min	49 min	5 min	22 °C	almost no wind
6.vi.2015	3 (2/1)	21.24	21.47	20.39	46 min	68 min	27 min	23 °C	light air
28.v.2016	6	21.05	21.10	20.31	34 min	39 min	5 min	-	-
1.vi.2016	≈ 8	21.15	21.45	20.35	40 min	70 min	30 min	24 °C	no wind, very wet after rain
2.vi.2016	≈ 8	21.15	21.45	20.36	39 min	69 min	30 min	24 °C	no wind, very wet after rain
3.vi.2016	≈ 8	21.15	21.45	20.37	38 min	68 min	30 min	24 °C	no wind, very wet after rain
11.vi.2016	5	21.20	21.40	20.43	37 min	57 min	20 min	-	-
n	241	average			36 min	58 min	22 min	21 °C	

Table 5. Data on flights of adults of *B. unicornis* at the locality of Hajnáčka – Buková (for abbreviations see Table 1).

Slovakia, Hajnáčka – Buková									
date	n (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
27.v.2008	5 (-/5)	21.10	21.35	20.26	44 min	69 min	25 min	22 °C	first or second warm day after a colder period of persistent rainfall; no wind
29.v.2008	4 (1/3)	21.10	21.40	20.29	41 min	71 min	30 min	21 °C	newly hatched, light-coloured ♂ (not included in these statistics) crawling on a t-shirt spread on the ground at the edge of the forest under an oak tree (<i>Quercus cerris</i>) at 19.55 CEST; during flights, no wind to light air
4.vii.2009	7 (3/4)	21.15	21.45	20.43	32 min	62 min	30 min	22 °C	-
5.vii.2009	3 (1/2)	21.15	21.30	20.43	32 min	47 min	15 min	20 °C	-
28.v.2010	4 (1/3)	21.10	21.25	20.26	44 min	59 min	15 min	-	♂ flying fast and high (ca 1.5–1.8 m above the ground) around a pile of logs near the edge of the forest
n (♂/♀)	23 (6/17)	average			39 min	62 min	23 min	21 °C	

away. This also applies to disturbances caused by too strong light source, e.g., from a headlamp. During flights, most beetles show light-aversion and avoid light sources; the individuals that were attracted to light were single cases only. These were mostly

Table 6. Data on flights of adults of *B. unicornis* at the locality of Gemerský Jablonec (for abbreviations see Table 1).

Slovakia, Gemerský Jablonec									
date	<i>n</i> (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
4.vii.2009	4 (1/3)	21.30	21.50	20.43	47 min	67 min	20 min	-	-
5.vii.2009	4 (3/1)	21.30	21.50	20.43	47 min	67 min	20 min	-	-
28.v.2010	4 (1/3)	21.00	21.15	20.26	34 min	49 min	15 min	-	-
<i>n</i> (♂/♀)	12 (5/7)		average		32 min	65 min	32 min		

Table 7. Data on flights of adults of *B. unicornis* at the locality of Hostice – Katarínka (for abbreviations see Table 1).

Slovakia, Hostice – Katarínka									
date	<i>n</i> (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
6.vi.2010	2 (-/2)	21.15	21.30	20.35	40 min	55 min	15 min	-	-

Table 8. Data on flights of adults of *B. unicornis* at the locality of Tekija (for abbreviations see Table 1).

Serbia, Tekija env.									
date	<i>n</i>	BF	EF	S	S-BF	S-EF	DF	T	note
27.v.2014	27	20.35	21.00	20.03	32 min	57 min	25 min	24 °C	after a period of persistent rainfall
28.v.2014	24	20.35	21.00	20.03	32 min	57 min	25 min	24 °C	dtto
12.vii.2014	9	20.45	21.15	20.16	29 min	59 min	30 min	19 °C	ca 5 hours after the rain; no wind
13.vii.2014	11	20.43	21.14	20.15	28 min	59 min	31 min	22 °C	full moon, clear skies, light breeze, storm in the distance
<i>n</i>	71		average		30 min	58 min	28 min	22 °C	

Table 9. Data on flights of adults of *B. unicornis* at the locality of Cordenons env. (for abbreviations see Table 1).

Italy, Cordenons env. (Glerean and Stefani 2019)									
date	<i>n</i> (♂/♀)	BF	EF	S	S-BF	S-EF	DF	T	note
9.ix.2018	2 (1/1)	20.10	20.30	19.35	35 min	55 min	20 min	21.5 °C	humidity 81%
16.v.2019	3 (2/1)	21.00	21.15	20.34	26 min	41 min	15 min	17 °C	male crawling on the ground at 21.20 CEST
24.v.2019	5 (5/-)	21.20	21.35	20.43	37 min	52 min	15 min	20 °C	humidity 70%
6.vi.2019	3 (2/1)	21.00	21.20	20.55	5 min	25 min	20 min	22 °C	humidity 70%
<i>n</i> (♂/♀)	13 (10/3)		average		26 min	43 min	18 min	20 °C	

long-distance flights that occurred later in the night. Very rarely a few individuals did fly to the illuminated canvas just after sunset when it was not yet completely dark (Tamás Kiss, Ondřej Sabol, Tibor Spevár obs., see Faunistic records). In most Czech and Slovak localities, adults of *B. unicornis* were flying together with *Od. armiger* and *Och. chrysomeloides* or *O. integriceps* (see Faunistic records and Juřena et al. 2008). Apparently, these species almost always occur together at the sites (see also below).

Feeding and nesting behaviour of bolboceratines

More than 50 individuals of *B. unicornis* were excavated from their burrows from depths of 5–60 cm during daylight hours. The length and the shape of the burrows var-

ied, with the male burrows often changing direction from vertical to horizontal, whereas the female burrows usually descended vertically, changing direction only slightly and often leading to depths greater than those of males. In the dry periods and at the end of the season, the beetles burrow to the depths of more than 50 cm (e.g., Tomáš Vendl obs., see Faunistic records). When excavating adults, sometimes two to three individuals were found in a single burrow, even of the same sex (e.g., two males; see Faunistic records and Juřena et al. 2008). Similar observations were made, for example, by Mollandin de Boissy (1906) in the congeneric species *B. gallicus*, and by Robert J. Sim in some American *Odonteus* species (Wallis 1928). In contrast, Manee (1908) excavated ca. 100 specimens of the North American bolboceratine *Bradycinetulus ferrugineus* (Palisot de Beauvois, 1809) in North Carolina, but he never found specimens of the same sex in the same burrow. On several occasions, individuals of *B. unicornis*, *Od. armiger*, and *Och. chrysomeloides* (or *O. integriceps*) have been found together in a single burrow (see Faunistic records and Juřena et al. 2008). Similarly, Robert J. Sim found representatives of three different genera *Bolbocerosoma*, *Eucanthus*, and *Odonteus* together in a single burrow (see Wallis 1928).

As for the feeding habits of *B. unicornis*, in none of the observations made by the author was the burrow found to lead to the sporocarp of hypogeous fungus or to the mycorrhizal roots of a shrub or tree. Nothing that could be considered as their food was ever found close to the buried individuals. In contrast, the Hungarian researchers repeatedly excavated the beetles near Budapest from the immediate vicinity of sporocarps of the large-spored pea truffle *Glomus macrocarpum*, which were approximately the size of a fingernail, together with more specimens of *Od. armiger* (Bratek et al. 1992; Merkl 2003, 2014, 2015; Náđai 2006; Merkl and Vig 2009). In addition, according to Ottó Merkl (pers. comm.), an adult of *B. unicornis* was found on a sporocarp of *Tuber* sp. in the Baranya County in southwestern Hungary (see also Merkl 2014), and Ćurćić et al. (2019) reported that one specimen was excavated under a hazel shrub (*Corylus avellana*) together with sporocarps of *Tuber* sp. in the Belgrade District of Serbia. These findings support earlier hypotheses about the mycetophagy of the species (cf. e.g., Sajó 1910a, b; Ohaus 1929; Roubal 1936; Koch 1989). For *B. gallicus*, Rahola Fabra (2004) reported that the burrows of beetles often led to dead roots in various stages of decomposition, but never to the sporocarps of hypogeous fungi. This is in contrast to the observations by Fabre (1900, 1907, 1920), who found adults of *B. gallicus* on the sporocarps of *Hydnocystis arenaria* and *Tuber requienii*, and Béguin (1906), who reported finding adults on sporocarps of *Tuber aestivum*. According to Rahola Fabra (2004), even in 20 years of field observations, the natural food of *B. gallicus* could not be determined with certainty. That author reported that in captivity, adults ingested sporocarps of *Tuber melanosporum*, *Rhizopogon* sp. and *Peziza* sp., but he did not consider this as unequivocal evidence of obligate mycetophagy by the species. According to Rahola Fabra (2004), dissection studies showed that the gut of adults of *B. gallicus* contained unspecified organic matter in 60% of individuals captured in the wild. Sim (1930) found that adults of the American bolboceratine *Odonteus darlingtoni* (Wallis, 1928) stored a mass of sporocarps of ectomycorrhizal basidiomycete *Rhizopogon pachyphloes* in their burrows, and Howden (1955) reported adults of this species feeding on sporocarps of *Rh. nigre-*

scens. In the European species *Od. armiger*, Miquel and Vasko (2014) reported finding one adult feeding on a large sporocarp of *Rh. luteolus*, partially decayed, together with two individuals of *Anoplotrupes stercorosus* (Hartmann in Scriba, 1791), and another individual feeding on a sporocarp of *Glomus microcarpum*. Furthermore, these authors reported that near burrows dug by adults of *Od. armiger* kept in captivity, sporocarps of *Endogone lactiflua* were found. In contrast, adults of the genus *Eucanthus*, for example, probably do not ingest any food at all (Howden and Cooper 1977). According to Howden (2003), even adults of the genus *Bolbocerosoma* do not feed, but this is contradicted by new findings by Japanese researchers, who found that adults of *Bolbocerosoma nigroplagiatum* (C. O. Waterhouse, 1875) feed on sporocarps of arbuscular mycorrhizal fungi (Higurashi and Tanahashi 2014; Aratani 2017; Higurashi et al. 2019). Higurashi and Tanahashi (2014) reported that bits of sporocarps of *Glomus* sp. were carried to the surface of the soil by adults of *B. nigroplagiatum*, then moved to another place and subsequently drawn into burrows. Spores of these fungi were found in the intestines of dissected specimens. Bezborodov (2009) and Bezborodov and Koshkin (2014a, b) reported that adults of *Bolbocerosoma zonatum* (Nikolaev, 1973) were repeatedly found under dry horse and cow dung in the Far East of Russia, in cavities covered with white mould, thus suggesting that the adults are mycetophagous; no burrows were observed under the dung. In Australia, dissections of bolboceratines and analysis of their faeces were carried out mainly by Houston and Bougher (2010), who found that the intestines or excrement of adults of *Blackbolbus*, *Blackburnium*, *Bolboleaus* and *Bolborhachium* species contained large quantities of spores of various species of hypogeous fungi (e.g., of the genera *Amarrendia*, *Hysterangium*, and *Scleroderma*), as well as immature unidentified sporocarp tissue, unidentified ascomycetes, or glomeralean hyphae and spores with varying quantities of soil. These authors also reported that only six of 120 specimens of bolboceratines collected while in flight (i.e., those specimens taken at lights or from light traps), and only 34 of 114 bolboceratines collected from burrows had food in their intestines. It is likely that the beetles feed only intermittently and possibly spend protracted periods without a meal. In many cases, their burrows may serve to provide them only with shelter until their next foray. In several genera, Houston and Bougher (2010) found no food present in the gut, which they explained by suggesting that feeding for these beetles is likely episodic, governed by weather events, and timing may be the key to finding specimens feeding. In the case of *B. unicornis*, it was not possible to dissect the individuals to determine the intestinal contents due to its strict protection in all EU countries. In the burrows of some Australian species of the genera *Blackbolbus*, *Blackburnium*, *Bolborhachium*, and *Elephastomus*, pieces of sporocarps of *Scleroderma* sp., *Hysterangium* sp., and unspecified hypogeous fungi of the families Hymenogasteraceae and Clathraceae have been found, but with no eggs or larvae present in the vicinity (Howden et al. 2007; Houston and Bougher 2010). This suggests that these fungi were food for adults only. In burrows of both *B. gallicus* and Australian bolboceratines, adults of some species of round fungus beetles (Leiodidae) have been found on the sporocarps of hypogeous fungi (Béguin 1906; Howden et al. 2007). In the case of *B. gallicus*, this was *Leiodes cinnamomea* (Panzer, 1793). Houston

and Bougher (2010) reported that some *Scleroderma* sporocarps found in burrows of *Blackbolbus frontalis* (Guérin-Méneville, 1838) were inhabited by numerous nitidulid beetles identified as *Thalycrodes mixtum* Kirejtshuk & Lawrence, 1992, and two sporocarps identified as *Hysterangium* sp. found in soil close to a burrow of *Blackbolbus frontalis* were infested with nematodes. Mycetophagy of adults of the genus *Ochodaeus*, representatives of which were collected together with *B. unicornis*, was also recently confirmed (Huchet et al. 2022).

Immature stages have only been described in a few species of bolboceratines (Arens 1922; Ritcher 1947, 1966; Howden 1955, 1964; Verdú et al. 1998, 2004; Rahola Fabra 2004; Howden et al. 2007; Houston 2011, 2016). In *B. unicornis*, no immature stages are known, and consequently nothing is known about the larval diet. During the excavation of adults from their burrows, no immature stages were found, similar to the reported cases of excavations of North American bolboceratines (Manee 1908; Wallis 1928; Sim 1930). As for the European representatives of the genus *Bolbelasmus*, the larva has only been described in *B. brancoi* (as *B. bocchus*, Verdú et al. 1998), and *B. gallicus* (Verdú et al. 2004), but even in these species larval nutrition has not been elucidated. Eggs have been described and/or photographed in only a few species of bolboceratines (Arens 1922; Howden 1955; Rahola Fabra 2004; Howden et al. 2007; Houston 2011, 2016). They are surprisingly large compared to the size of the adults. For *B. gallicus*, Rahola Fabra (2004) reported egg dimensions to be $7.0\text{--}8.0 \times 4.0$ mm, but the egg photographed next to the female and scale was actually 7.0×4.6 mm, whereas the body length of the female was ca. 14 mm (calculated from the scale line). Howden et al. (2007) noted that two eggs of the Australian species *Bolborhachium anneae* Howden, 1985 measured 6.5×6.2 mm and 7.3×6.4 mm while two eggs of the slightly larger *B. recticorne* (Guérin-Méneville, 1838) measured 7.2×5.9 mm and 8.1×6.5 mm. The largest female of *B. anneae* measured 15.1 mm in length, while the largest female of *B. recticorne* measured 18.8 mm in length. According to Houston (2011), the eggs of another Australian bolboceratine *Blackburnium reichei* (Guérin-Méneville, 1838) weighed 45–56% as much as the females that laid them and measured $9.5\text{--}10.5 \times 7.5\text{--}9.0$ mm. On the other hand, the eggs of the North American bolboceratine *Odonteus darlingtoni* are not so large compared to the adults: they measure ca. 2.4×1.5 mm, whereas the adults are ca. 10 mm in length (Howden 1955). Similarly, for the European species *Od. armiger*, Arens (1922) reported the length of the egg to be 2.5 mm (body length of adults is usually 6–10 mm). Rahola Fabra (2004) reported that the females of *B. gallicus* have two ovaries, each composed of six ovarioles, as in other representatives of the family Geotrupidae (cf. Ritcher and Baker 1974), with only one ovariole functioning at any time, in alternating cycles (cf. Willimzik 1930). The fecundity of females of *B. gallicus* is very low (probably one to four eggs in a lifetime), nevertheless, according to Rahola Fabra (2004), populations are relatively stable; he stated that the female of *B. gallicus* fixes its giant egg to the ceiling of a small egg-shaped brood cell using soil mixed with its own excreta. All the cells found by Rahola Fabra were empty, which means that they did not contain anything that could provide food for the future larvae. Similarly, Arens (1922) reported that the brood cells with eggs of

Od. armiger contained no provision, but in a few cases he found pieces of unspecified fungi or humus in the burrows. Also, Miquel and Vasko (2014) found 16 empty brood cells of *Od. armiger*. The fact that the brood cells did not contain any material collected by females differs from what Howden (1955) observed in another species of the subfamily Bolboceratinae, where females lined their brood cells with material brought in from outside (surface humus, dried dung) that could be a food for the larva. In two species of the genus *Bolborhachium* the brood cells were filled with fine black humus, perhaps mixed with fungi (Howden 1985; Howden et al. 2007). In contrast, according to Houston (2016), the brood cells of some Western Australian bolboceratines, such as *Bolborhachium recticorne* and some congeners, were formed from darker surface soil, but no food was found. Eggs and larvae of these species collected in the field were reared in their original cells and in artificial cells made in soil. Of three instars, the first contained the already developed second instar and did not feed. Second and third instars nibbled at the walls of their cells as if feeding, grew in size, and increased their weight 2.5–3.0 times. However, they turned over little soil, ingested little solid material, and rarely passed faeces, so ingestion and digestion of ‘humus’ (finely divided plant detritus) is unlikely to account for all (if any) of their weight gain. As the contents of the larval intestine were hygroscopic, perhaps larvae ingest salts and/or humic and fulvic acids that enable them to absorb water (Houston 2016). This author also suggested that the soil bacteria may be a source of nutrition for the larvae. This is also consistent with Houston’s finding of two newly emerged adults of *Blackburnium reichei* in closed, earthen cells at depths of 60 and 72 cm, with no traces of faecal material or uneaten provision being observed in or near these cells (Houston 2011). The hypothesis that larvae of Australian bolboceratines do not ingest solid food is supported by the description of their morphology. Houston (2011) reported that compared with free-living scarabaeoid larvae (e.g., Melolonthinae, Dynastinae, Trogidae) where the head and mandibles are strongly sclerotised and the legs well developed with strong tarsal claws, the larvae of all known bolboceratines are degenerate. According to Houston (2011), the larva of *Blackbolbus hoplocephalus* (Lea, 1916) provides the most extreme example of degeneration known to date. Its immobility and vestigial appendages (particularly its simple, feeble mandibles) suggested it was a non-feeding, resting stage. Importantly, though, the mandibles of the second instar (judging from its exuvia) were equally feeble and consistent with a no-feeding hypothesis (Houston 2011). Houston went on to point out another feature of the larvae of known bolboceratines: the relatively slender abdomen which contrasts with the swollen abdomen of many other Scarabaeoidea, suggesting at least a different feeding biology and possibly hinting at a reduction or even absence of feeding. The very simple form of the larval intestine found by Houston (2011) in *Blackburnium reichei* when compared with the intestines of larvae of other scarabaeids (e.g., Areekul 1957) and its emptiness are consistent with loss of feeding. Similarly, Higurashi and Tanahashi (2014) and Higurashi et al. (2019) recorded giant eggs, larvae, and pupae of *Bolbocerosoma nigroplagiatum* excavated from a depth of ca. 80 cm, with the larvae having poorly developed appendages (mandibles and legs). Howden (1955) reported that larvae of the North American bolboceratines *Odonteus*

darlingtoni, *O. liebecki* (Wallis, 1928), and *Bolbocerosoma farctum* (Fabricius, 1775) feed on humus, carefully sifting it from a provision of humus-rich sand filling the lower ends of burrows. This is consistent with earlier observations by Robert J. Sim, who assumed that females of *Odonteus simi* (Wallis, 1928) lay their eggs in humus formed into an elongated mass at the lower ends of the burrows (Wallis 1928).

Since we have virtually no knowledge of the diet of adults or larvae of *B. unicornis*, we can only speculate on what its diet consists of. Given the findings of Australian and Japanese researchers on related species, the likely food of adults appears to be hypogeous fungi (spores, hyphae, and sporocarps), while the food of larvae could be fine soil humus and/or soil bacteria. The previous hypothesis that the larvae of *B. unicornis* feed on sporocarps of hypogeous fungi (e.g., Bartenev et al. 1997; Náday 2006; Juřena et al. 2008; Kaděra 2017; Németh 2015; Nuř and Jäger 2020) is not supported by observation and seems very unlikely considering the observations in other species of bolboceratines. The larval morphology of the genus *Bolbelasmus* is very similar to that of larvae of the genera *Bolbocerosoma* and *Bolborhachium* (Verdú et al. 1998, 2004), which suggests a similar way of life, including feeding habits.

Life cycles of bolboceratines

Life cycles have been documented for only a few bolboceratine species (Houston 2011, 2016). Houston (2016) found that for three Australian species (*Bolborhachium recticorne*, *Blackburnium reichei*, and *Bolboleaus hiaticollis* Howden, 1985), the period between discovery of an egg and hatching of the larva was 15–35 days. According to Houston, duration of the larval stage in *Bolborhachium recticorne* ranged from 63 to 95 days ($n = 6$) and for one *Blackburnium reichei* larva, it was 44 days. One larva of *Bolboleaus hiaticollis* pupated 81 days after being found while another (hatched from an egg) survived for at least 13 months before dying. Based on the Houston's data, development from egg to adult in *Bolborhachium recticorne* could require 129–159 days or more. As newly emerged adults remained in their natal cells for at least 30 days while their integuments harden and darken, total development time (egg to active adult) might require 6 months or more, according to Houston. Houston (2016) suggested the possibility that in *Bolboleaus hiaticollis*, mature larvae enter a dormant stage, thereby extending the development time even further. Houston (2011) recorded excavating a third larval instar of *Blackbolbus hoplocephalus* that remained dormant for 105 days before pupating.

Assuming that the development of *B. unicornis* is similar, it is very likely that only adults, both old and newly emerged, overwinter. This assumption is supported by numerous records where both old, dark-coloured individuals with heavily abraded teeth of fore tibiae and fresh, pale-coloured individuals with sharp protibial teeth have been recorded at the beginning of the season (pers. obs.). Some bolboceratines have overlapping generations. For example, in the genus *Odonteus*, eggs, larvae, pupae, and adults have been observed together in a single branching burrow (Jameson 2002; Staines and Staines 2020).

Seasonal dynamics of *B. unicornis*

In the Pannonian Basin, the centre of the distribution of *B. unicornis*, adults are active from May to September, exceptionally as early as April and as late as October, with a significant peak in June and the first half of July (Fig. 19). Very few data are available from the other parts of the distribution area. It appears that in the southernmost part of the range, adults may be active as early as March, which is supported, for example, by the record from East Thrace (see Hillert et al. 2016 and Faunistic records in this study). The seasonal dynamics of the species are always significantly influenced by precipitation changes during the year. It is likely that only the adults overwinter, as reported by Caillol (1913) for the congeneric species *B. gallicus* (see also Rahola Fabra 2004).

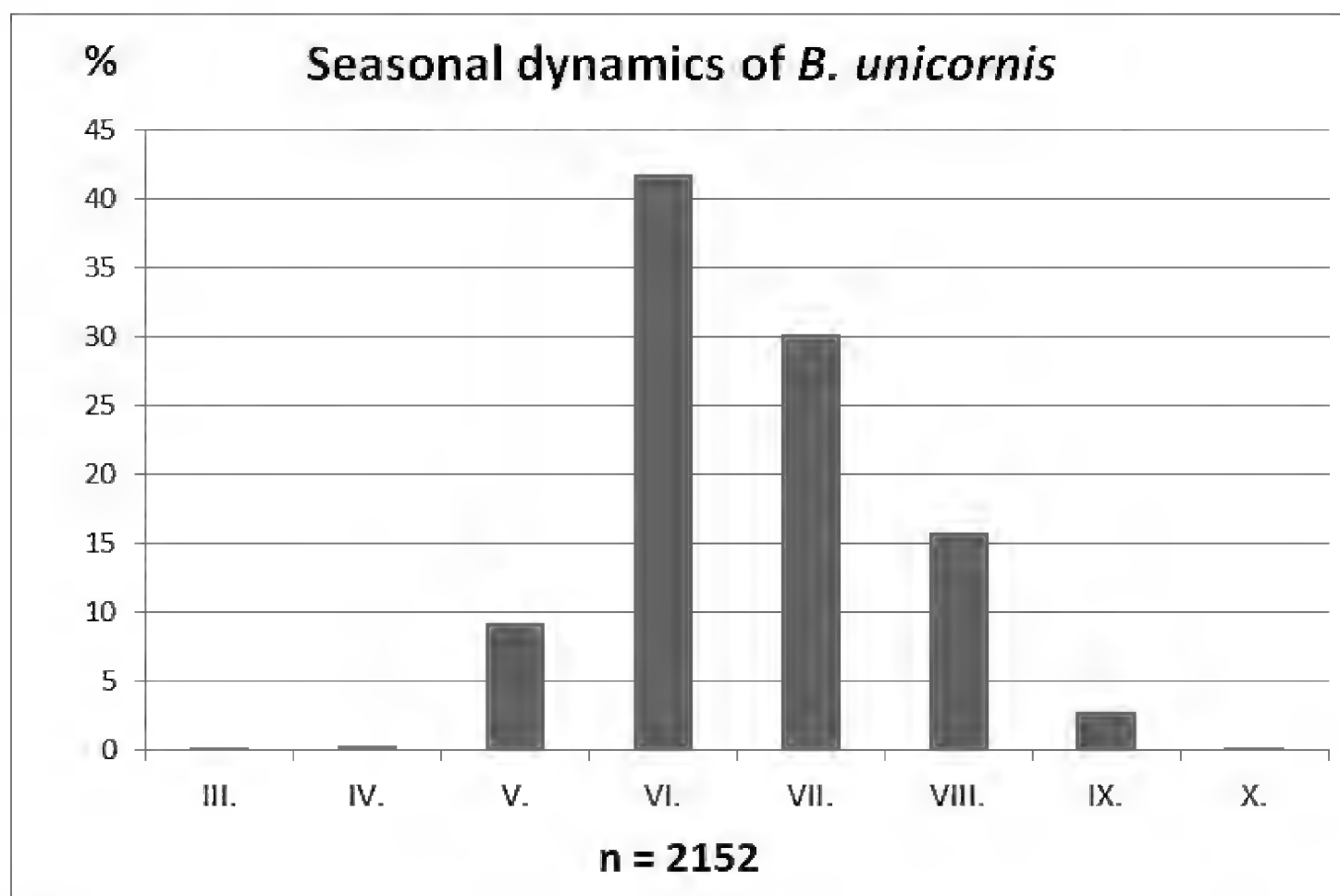


Figure 19. Seasonal dynamics of *B. unicornis* (the number of specimens from each country included in these statistics: Slovakia – 1392, Hungary – 350, Ukraine – 168, Serbia – 87, Romania – 79, Austria – 44, Czech Republic – 31).

Habitat preferences of *B. unicornis*

Bolbelasmus unicornis is a stenotopic species, characteristic of Pannonian steppes, forest-steppes and sparse deciduous forests, especially dominated by oaks. It is often found on sandy substrate (e.g., surroundings of Győr, Kiskunság National Park), sandy-loess substrate (e.g., localities around the village of Čejč), gravelly-sandy-loess substrate (e.g., Dunajské luhy Protected Landscape Area), loess substrate (e.g., wider surroundings

of Štúrovo, Cerová vrchovina Mts, Gödöllő Hills, Dniester Canyon National Nature Park) or limestone substrate (e.g., Slovak Karst, Aggtelek National Park, some localities around Budapest). Characteristic habitats are steppe or forest-steppe pastures at the edges of oak forests (e.g., Cerová vrchovina Mts, Slovak Karst), of oak-beech or beech forests (e.g., Slanské kopce hills, Đerdap National Park, some localities in Romania), oak-hornbeam or hornbeam forests (e.g., Pirot District of Serbia, Kaniv Nature Reserve in Ukraine), and of shrub zones (with e.g., *Crataegus oxyacantha*, *Prunus spinosa*, and *Rosa canina*). In the Kiskunság National Park it occurs in the Pannonic sand dune thicket (*Junipero-Populetum albae*) (Merkl 2014). Occurrences of *B. unicornis* in completely treeless habitats are known for the northern half of its range (Czech Republic, Slovakia, Hungary), while further south the species occurs in areas of more extensive forest cover (Serbia, Romania, Bulgaria). In eastern Ukraine (Dnipro City) the species occurs in sparse oak forest (Fig. 15). Also, the only known recent record from Croatia was made in forest (Koren 2017). Other typical habitats are remnants of the native steppe grasslands between vineyards, former steppe and forest-steppe pastures, remnants of steppe or forest-steppe in agricultural landscapes that have been preserved due to their inaccessibility to agricultural machinery (e.g., localities around Čejč and many sites in Hungary). In the case of hilly terrain, *B. unicornis* mainly prefers south- and southwest-facing slopes, and less frequently slopes inclined to the southeast or even to the north (e.g., Fruška Gora National Park – see Faunistic records in this study, and Gorna Malina – see Zaharieva-Stoilova 1974).

It seems that the fundamental requirement of the species is natural vegetation cover and soil undisturbed by agriculture. The same was noted by Sajó (1897), who stated that the species occurred in a dry oak forest on a hill near Kis-Szent-Miklós (currently Órbottyán – Órszentmiklós), but it disappeared as soon as the hill was converted to farmland. The species is probably also very sensitive to the use of chemicals in agriculture and forestry. It seems to be threatened by the overgrowth of invasive plant species such as *Robinia pseudoacacia* or *Ailanthus altissima* in steppe and forest-steppe habitats. Furthermore, the extensive removal of shrubs such as *Crataegus* sp., *Rosa canina*, *Corylus avellana*, and trees (e.g., *Quercus* spp., *Populus* spp., *Prunus spinosa*) and taller herbaceous plants, as well as too intensive sheep grazing seem to have negative effects on the presence of *B. unicornis* (cf. also Németh 2015). The largest known population of the species in Europe at the Panský diel site on Kopáč Island near Bratislava, Slovakia (Figs 4, 5) was severely decimated by the inappropriate conservation management of the site (pers. obs., cf. also Majzlan 2020).

Central European sites with substantial populations of *B. unicornis* are characterised by the occurrence of plant species such as *Quercus* spp., *Crataegus oxyacantha*, *Prunus spinosa*, *Rosa canina*, *Festuca* spp., *Thymus* spp., *Orobancha* spp., *Scabiosa ochroleuca*, *Euphorbia cyparissias*, *Achillea millefolium*, and *Artemisia* spp.

On describing the potential habitat of the related *B. gallicus* in southern France, Rahola Fabra (2004) lists the following plant species: *Quercus ilex*, *Q. coccifera*, *Q. pubescens*, *Olea europaea*, *Pinus halepensis*, *P. pinea*, *Juniperus oxycedrus*, *Buxus sempervirens*, *Cistus monspeliensis*, *C. albidus*, *Genista hispanica*, *Brachypodium retusum*, *Thymus vulgaris*, *Sedum* sp., *Coronilla glauca* and *Viburnum tinus*.

The Coleoptera that co-occur in Central European localities with *B. unicornis* include *Lethrus apterus* (Laxmann, 1770), *Odonteus armiger*, *Ochodaeus chrysomeloides*, *O. integriceps*, *Gymnopleurus* spp., *Carabus montivagus* Palliardi, 1825, *C. scabriusculus* Olivier, 1795, *Capnodis tenebrionis* (Linnaeus, 1761), *Perotis lugubris* (Fabricius, 1777), *Ptosima undecimmaculata* (Herbst, 1784), *Sphenoptera* spp., and *Agrilus albogularis* Gory, 1841 (observations by many collectors including the author).

The elevation of the sites where *B. unicornis* has been recorded varies between 20 and 800 m a.s.l. The average altitude of all known localities for which it could be at least approximately determined ($n = 351$) is 220 m a.s.l. It is therefore a species of lowland and lower hills.

Monitoring methods

The most effective method for monitoring this species is to capture adults during their flights after sunset with a net using a flashlight, preferably a headlamp, in suitable microhabitat. This collecting method was employed as early as the 1920s by Rudolf Čepelák (see Čepelák 1925). The effectiveness of this method is evidenced by the large number of specimens collected by him, which are still scattered in numerous collections of museums and private collectors (see Faunistic records). Typically, the flights of beetles occur in very limited areas, and the concentration of flying individuals can vary considerably from place to place. For example, more flying beetles can be observed above grassy trails with ruts made by agricultural machinery or above paths trodden by humans or animals. Flying beetles can also be detected by the hum of their wings similar to that of a flying European hornet (*Vespa crabro* Linnaeus, 1758), as reported by Čepelák (1925) and Roubal (1936). However, sometimes the beetles fly almost noiselessly (pers. obs.).

Alternatively, during the day, one may find the beetles in their burrows, which are indicated by small piles of excavated soil at the entrances (so called “push-ups”). These push-ups are similar to those of some large ground-nesting bees but the push-ups of the bees are conical, composed of uniformly loose soil about a central entrance, whereas the soil pushed up by the earth-borer beetles tends to form an irregular pile of lumps (Figs 5E, 8A–D, 15E, F). If the individual is present in the burrow, the entrance is often covered by a pile of excavated soil. An uncovered hole usually indicates that the beetle is no longer present. Similarly, if a push-up is weathered down, it is usually old and the beetle may no longer be present in the burrow. This method is less effective on grassy sites as the push-ups may be screened from view.

Light trapping appears to be ineffective to capture this species (cf. also Cséfalvay 2015), as the beetles show light-aversion during flights and avoid light sources. Only occasional specimens which may be long-distance flyers come to the light later in the night. On very rare occasions, a few individuals have been observed flying to the light (on an illuminated canvas) just after sunset. It is likely that the beetles respond differently to different light sources, something requiring further research.

Bolbelasmus unicornis is also difficult to find due to the fact that observable activity of adults (flights and digging underground tunnels with push-ups) occurs only after heavy rains, when the soil is damp and loose enough for the beetles to burrow easily. During the dry periods, when the soil is hard, and also in winter, the beetles are buried deeper in the ground and show no above-ground activity, making it very difficult to find them.

Excerpt from the diary of Rudolf Čepelák

Below is the translation of a passage on *B. unicornis* from the diary of the excellent Czech coleopterist Rudolf Čepelák (1886–1972; Fig. 20), the discoverer of an efficient method of collecting this beetle. This text was written in the second half of the 1960s (Svätopluk Čepelák pers. comm., 2021). Čepelák here supplemented and specified his previously published observations (Čepelák 1925) from sites north of Zlatovce near Trenčín, where he worked as a teacher in 1923–1939 (see Kolečka 1979):

“Bolbelasmus unicornis Schrank

From 1.vi. to 15.vii. Zlatovce (Malá hora hill; Vinohrady), Lutov (Pálenice hill), and certainly from Trenčín southwards everywhere on the south-eastern slopes.

The area of Malá hora is sparsely covered with grass, which reaches 40–50 cm in places. If it is a quiet evening (no wind), preferably without moonlight, at 9 pm they start flying about 20–30 cm above the ground. In my right hand I have a net with a handle about 10 cm long, not white but dark, and in my left hand a torch. I bend down and

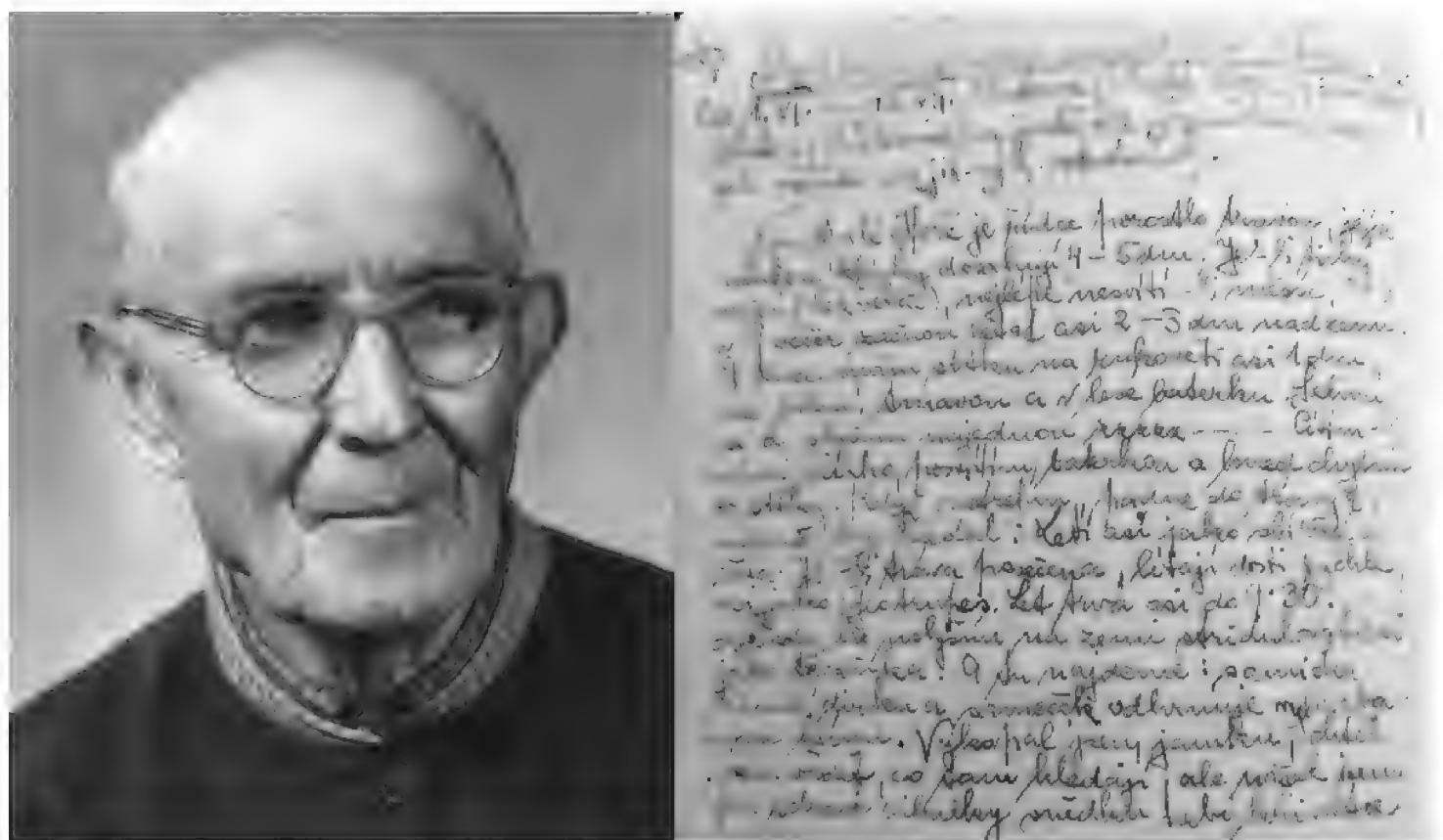


Figure 20. Rudolf Čepelák (born 16 April 1886 in Kutná Hora, Austria-Hungary, died 21 December 1972 in Český Brod, Czechoslovakia) and an excerpt from his diary with notes on collecting of *B. unicornis*.

suddenly hear ‘zzzzz...’. If I feel it’s very close, I shine the torch and immediately catch it with the net. If I miss, it falls into the grass, where I would look for it vainly. It flies like a bee collecting pollen. If the grass is cut, they fly quite fast, like *Geotrupes*. The flights continue until ca. 9.30 pm. Sometimes I hear it on the ground, stridulating like a long-horn beetle. And then we see: the female digging a hole and the male removing away the excavated soil. I dug a hole to see what they were looking for, but all I found were healthy *Ornithogalum* or *Gagea* bulbs.”



Figure 21. Drawing by Regina & David Král with the motif of *B. unicornis*, sent as PF 1988.

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References

- Ádám L (1994) A check-list of the Hungarian Scarabaeoidea with the description of ten new taxa (Coleoptera). *Folia Entomologica Hungarica* 55: 5–17. http://publication.nhmus.hu/pdf/folemtom/FoliaEntHung_1994_Vol_55_5.pdf
- Agoglitta R, Barbero E, Ragusa E, Zunino M (2006) Catalogo sistematico e topografico dei Geotrupidae e Scarabaeidae degradatori della Sicilia e delle isole circumsiciliane (Coleoptera: Scarabaeoidea). *Boletín de la Sociedad Entomológica Aragonesa* 39: 181–204. http://sea-entomologia.org/Publicaciones/PDF/BOLN39/181_204BSEA39ScarabeidaeSicilia.pdf
- Allenspach V (1970) Coleoptera Scarabaeidae, Lucanidae. *Insecta Helvetica. Catalogus* 2. Imprimerie la Concorde, Lausanne, 186 pp.
- Alonso-Zarazaga MA, Evenhuis NL (2017) Revised dating of Panzer's *Faunae insectorum Germanicae initia*. *Deutschlands Insecten (1792–1810)*, based primarily on the Leipzig Book Fair Catalogs. *Sherbornia* 4(1): 1–8. https://digital.csic.es/bitstream/10261/194992/1/Revised_Alonso_Art2017.pdf
- Alonso-Zarazaga MA, López-Colón JI, Vít S (2013) Geotrupidae. *Fauna Europaea*, version 2017.06. <https://fauna-eu.org> [accessed 3 July 2021]
- Anonymus (2015) Plan de management integrat pentru siturile Natura 2000 ROSPA0104 Bazinul Fizeșului, ROSCI0099 Lacul Știucilor-Sic-Puni-Bonțida și pentru ariile protejate de interes național Lacul Știucilor, Stufărișurile de la Sic, Valea Legiilor și Pădurea Ciuașului. [Integrated management plan for Natura 2000 sites ROSPA0104 Fizeșului Basin, ROSCI0099 Știucilor-Sic-Puni-Bonțida Lake, and for the protected areas of national interest Știucilor Lake, Stufărișurile de la Sic, and Valea Legiilor and Ciuașului Forest]. Ministerul Mediului Apelor și Padurilor, București, 325 pp. [in Romanian] http://www.mmediu.gov.ro/app/webroot/uploads/files/2015-12-16_PM_ROSCO0099_ROSPA0104_LW_AD.pdf [accessed 1 November 2020]
- Anonymus (2019) A talajfelszíni- és egyenesszárnyú fauna alapállapot felmérése a Gönyői-homokvidék projektterületén. [Survey of the baseline condition of the soil surface and fauna of Orthoptera in the Gönyői Sands area]. Acrida Nature Conservation Research Ltd., Tapolca, 3 pp. [unpublished report for the Fertő-Hanság National Park Directorate,

- in Hungarian] https://www.ferto-hansag.hu/upload/document/482/life-ip-grassland-hu_egyenesszarnyu-felmeres_2019_p06n.pdf [accessed 28 February 2021]
- Aratani K (2017) 500 (Col.: Bolboceratidae). A record of the earth-borer beetle *Bolbocerosoma nigroplagiatum* from the island of Satsuma Iōjima [in Japanese]. *Pulex* 96: 732–733. http://www.agr.kyushu-u.ac.jp/lab/entomology/Pulex/Pulex_No96.pdf
- Areekul S (1957) The comparative internal larval anatomy of several genera of Scarabaeidae (Coleoptera). *Annals of the Entomological Society of America* 50(6): 562–577. <https://doi.org/10.1093/aesa/50.6.562>
- Arens LE (1922) K biologii *Odontaeus armiger* Scop. (Coleoptera). [On the biology of *Odontaeus armiger* Scop. (Coleoptera)]. *Izvestiya Petrogradskogo Nauchnogo Instituta Imeni P. F. Lesgafta* 5: 241–246. [in Russian]
- Arnone M (2010) Quinto contributo alla revisione della collezione coleotterologica di Enrico Ragusa: Scarabaeoidea. *Il Naturalista Siciliano* 34: 61–172. <http://www.sssn.it/PDF/PDF%20NS%2034/061-172.pdf>
- Arnone M, Massa B (2010) A new species of *Bolbelasmus* Boucomont, 1911 from Sicily (Italy). *Il Naturalista Siciliano* 34: 401–414. <http://www.sssn.it/PDF/PDF%20NS%2034/401-414.pdf>
- Bacal S, Munteanu N, Toderaş I (2013) Checklist of beetles (Insecta: Coleoptera) of the Republic of Moldova. *Brukenthal. Acta Musei* 8(3): 415–450.
- Ballerio A (2008) Insetti da proteggere: la tutela entomologica in Italia. *Quaderni della Stazione di Ecologia del Civico Museo di Storia Naturale di Ferrara*, 18: 21–35. <https://storianaturale.comune.fe.it/modules/core/lib/d.php?c=wyHKU>
- Ballerio A, Rey A, Uliana M, Rastelli M, Rastelli S, Romano M, Colacurcio L (2014) Coleotteri Scarabeoidei d'Italia. *Piccole Faune*. Marco Serra Tarantola, Brescia. <http://www.societaentomologicaitaliana.it/Coleotteri%20Scarabeoidea%20d'Italia%202014> [accessed 10 December 2020]
- Balthasar V (1933) Pokus o rozbor složek fauny slovenských a podkarpatoruských coprophagních Scarabaeidů z hlediska zoogeografie na podkladě oekologickém. Ein Versuch einer Analyse der coprophagen Fauna der Karpathen-Länder auf Grund der oekologischen Zoogeographie. *Časopis Učené Společnosti Šafaříkovy* 7: 198–204. [in Czech with German summary]
- Baraud J (1977) Coléoptères Scarabaeoidea. Faune de l'Europe occidentale: Belgique, France, Grande-Bretagne, Italie, Péninsule Ibérique. *Nouvelle Revue d'Entomologie, Supplément* 4: 1–352.
- Baraud J (1992) Coléoptères Scarabaeoidea d'Europe. Faune de France, France et régions limitrophes, 78. *Fédération Française des Sociétés de Sciences Naturelles & Société Linnéenne de Lyon*, Paris – Lyon, 856 pp. [https://faunedefrance.org/bibliotheque/docs/J.BARAUD\(FdeFr78\)Col%C3%A9opt%C3%A8resScarabaeoidea.pdf](https://faunedefrance.org/bibliotheque/docs/J.BARAUD(FdeFr78)Col%C3%A9opt%C3%A8resScarabaeoidea.pdf)
- Barbero E, Cavallo O (1999) I coleotteri scarabaeoidea degradatori (Trogidae, Geotrupidae, Scarabaeidae, Aphodiidae) del Museo civico “F. Eusebio”. *Alba Pompeia* 20(1): 65–81.
- Bartenev AF, Shatrovskiy AG, Vovk DV (1997) Obzor semeystv zhukov (Coleoptera) Ukrainy. Chast' 2. Polyphaga (Staphyliniformia: Hydrophiloidea; Scarabaeiformia: Scarabaeoidea). A synopsis of the families of beetles (Coleoptera) of Ukraine. Part 2. Polyphaga (Staphyliniformia: Hydrophiloidea; Scarabaeiformia: Scarabaeoidea). *Izvestiya Kharkovskogo Ento-*

- mologicheskogo Obshchestva 5: 5–21. [in Russian with English Summary] https://www.zin.ru/animalia/coleoptera/pdf/bartenev_shatrovsky_vovk.pdf
- Baudi di Selve F (1889) Catalogo dei Coleotteri del Piemonte. Annali della Reale Accademia d'Agricoltura di Torino 32: 51–274. <https://doi.org/10.5962/bhl.title.24377>
- Bedel LEM (1911) Faune des Coléoptères du Bassin de la Seine. Scarabaeidae. Publications de la Société Entomologique de France 4(1): 1–164. <https://gallica.bnf.fr/ark:/12148/bpt6k1176282r/f11.item>
- Béguin L (1906) Mœurs du *Bolboceras gallicum* Muls. (Col.). Bulletin de la Société Entomologique de France 1906(8): 93–94. <https://www.biodiversitylibrary.org/item/37019#page/133/mode/1up>. <https://doi.org/10.3406/bsef.1906.23896>
- Benasso G (1971) Una specie nuova per il Friuli: *Bolbelasmus unicornis* (Schrank) (Coleoptera, Geotrupidae). Atti del Museo Civico di Storia Naturale di Trieste 27: 167–172.
- Bense U, Maus C, Mauser J, Neumann C, Trautner J (2000) Die Käfer der Markgräfler Trockenaue. In: Landesanstalt für Umweltschutz Baden-Württemberg (Ed.) Vom Wildstrom zur Trockenaue. Natur und Geschichte der Flusslandschaft am südlichen Oberrhein. Verlag Regionalkultur, Ubstadt-Weiher, 347–460. <https://d-nb.info/959301941/04>
- Bertolini S de (1871) Una inondazione dell'Adige. Notizie entomologiche. Bullettino della Società Entomologica Italiana 3(1): 41–46. <https://archive.org/details/bollettinodellas-34187172soci/page/n49>
- Bertolini S de (1872) Catalogo sinonimico e topografico dei coleotteri d'Italia. Tipografia Cenniniana, Firenze, 263 pp. <https://doi.org/10.5962/bhl.title.8783>
- Bertolini S de (1874) Notizie di escursioni e di cacce entomologiche II. Bullettino della Società Entomologica Italiana 6: 99–102. <https://www.biodiversitylibrary.org/item/39662#page/465/mode/1up>
- Bertolini S de (1891) Contribuzione alla Fauna trentina dei Coleotteri. Bullettino della Società Entomologica Italiana 23: 169–217. <https://www.biodiversitylibrary.org/item/55175#page/201/mode/1up>
- Bertolini S de (1899a) Catalogo dei Coleotteri d'Italia. Tipografia e litografia sordo-muti di L. Lazzeri, Siena, 144 pp.
- Bertolini S de (1899b) I Coleotteri del Trentino. Saggio di un elenco delle specie di Coleotteri appartenenti alla regione faunistica del Trentino. Società Entomologica Italiana, Tipografia di M. Ricci, Firenze, 399 pp.
- Bezborodov VG (2009) O khorologii i ekologii *Bolbocerodema zonatum* Nikolajev, 1973 (Coleoptera: Scarabaeoidea, Bolboceratidae). [On the Chorology and Ecology of *Bolbocerodema zonatum* Nikolajev, 1973 (Coleoptera: Scarabaeoidea, Bolboceratidae)]. In: Sektsiya 3. Bioraznoobraziye zhivotnykh i mikroorganizmov. Mezhdunarodnaya nauchno-prakticheskaya konferentsiya «Biologicheskoye raznoobraziye i ustoychivoye razvitiye prirody i obshchestva», posvyashchonnaya 75-letiyu KazNU im. al'-Farabi i biologicheskogo fakul'teta. [Session 3. Biodiversity of animals and microorganisms. International Scientific-Practical Conference “Biodiversity and Sustainable Development of Nature and Society” held on the occasion of the 75th anniversary of Al-Farabi Kazakh National University and the Faculty of Biology]. Almaty, 17–20. [in Russian]

- Bezborodov VG, Koshkin ES (2014a) A Review of Bolboceratidae (Coleoptera, Scarabaeoidea) species from the Russian Far East. *Entomological Review* 94(9): 1313–1319. <https://doi.org/10.1134/S0013873814090127>
- Bezborodov VG, Koshkin ES (2014b) Obzor vidov Bolboceratidae (Coleoptera, Scarabaeoidea) Dal'nego Vostoka Rossii. [A Review of Bolboceratidae (Coleoptera, Scarabaeoidea) species of the Russian Far East]. *Zoologicheskii Zhurnal* 93: 953–959. [in Russian] <https://doi.org/10.7868/S0044513414060038>
- Bidas M (2012) Rzadkie chrząszcze (Coleoptera) Góry Rzepki w Górach Świętokrzyskich. Rare beetles (Coleoptera) of Rzepka Mountain in Świętokrzyskie Mountains. *Naturalia* (Kielce) 1: 133–135. [in Polish with English summary]
- Bielz EA (1887) Die Erforschung der Käferfauna Siebenbürgens bis zum Schlusse des Jahres 1886. *Verhandlungen und Mittheilungen des Siebenbürgischer Vereins für Naturwissenschaften in Hermannstadt* 37: 27–114. <https://www.biodiversitylibrary.org/item/104997#page/425/mode/1up>
- Bleich O, Gürlich S, Köhler F (2022) Verzeichnis und Verbreitungsatlas der Käfer Deutschlands. World Wide Web electronic publication. www.coleokat.de [accessed 7 January 2022]
- Bolla J von (1859) Beitrag zur Kenntniss der Kolopteren-Fauna Presburg's. *Verhandlungen des Vereins für Naturkunde zu Presburg* 4: 23–44. <https://www.biodiversitylibrary.org/item/107030#page/921/mode/1up>
- Bouchard P, Bousquet Y (2020) Additions and corrections to “Family-group names in Coleoptera (Insecta)”. *ZooKeys* 922: 65–139. <https://doi.org/10.3897/zookeys.922.46367>
- Boucomont A (1912) Scarabaeidae: Taurocerastinae, Geotrupinae. In: Junk W, Schenkling S (Eds) *Coleopterorum Catalogus*, Pars 46. Wilhelm Junk, Berlin, 1–47. <https://www.biodiversitylibrary.org/item/276306#page/393/mode/1up>
- Bourgeois J (1904) Catalogue des Coléoptères de la chaîne des Vosges et des régions limitrophes. *Bulletin de la Société d'Histoire Naturelle de Colmar, Nouvelle Série* 7: 1–93. <https://doi.org/10.5962/bhl.title.8778>
- Bousquet Y (2016) Litteratura Coleopterologica (1758–1900): A guide to selected books related to the taxonomy of Coleoptera with publication dates and notes. *ZooKeys* 583: 1–776. <https://doi.org/10.3897/zookeys.583.7084>
- Brancsik C (1871) *Die Käfer der Steiermark*. Verlag von Paul Cieslar, Graz, 114 pp. <https://doi.org/10.5962/bhl.title.104482>
- Brancsik C (1899) Additamenta ad faunam Coleopterorum Comitatus Trencsiniensis. Series quarta. *A Trencsén Vármegyei Természettudományi Egylet* 21–22: 39–42. https://adt.arcanum.com/en/view/MTA_TrencsenyVmTermTudEgyletEvkonyve_1898-1899/?pg=42&layout=s
- Brancsik C (1905) Enumeratio Coleopterorum in Comitatu Trencsiniensi adhuc inventorum. *A Trencsén Vármegyei Természettudományi Egylet* 27–28: 9–116. https://adt.arcanum.com/en/view/MTA_TrencsenyVmTermTudEgyletEvkonyve_1904-1905/?pg=10&layout=s
- Bratek Z, Papp L, Merkl O, Takács V (1992) Föld alatti gombákon élő rovarok. [Insects living on hypogeous fungi]. *Mikológiai Közlemények* 31: 55–66. [in Hungarian] http://bruchiteam.nhmus.hu/Merkl/Bratek_Papp_Merkl_Takacs_fold_alattai_gombakon_elorovarok-mikologiai_kozlemenyek_vol_31_1_2_1992.pdf

- Brechtel F, Schmid-Egger C, Neumann C, Baum F (1995) Die Trockenauen am südlichen Oberrhein. Ein Naturraum bundesweiter Bedeutung ist von Zerstörung bedroht. *Naturschutz und Landschaftsplanung* 27: 227–236.
- Brelih S, Kajzer A, Pirnat A (2010) Gradivo za favno hroščev (Coleoptera) Slovenije. 4. prispevek: Polyphaga: Scarabaeoidea (= Lamellicornia). Material for the beetle fauna (Coleoptera) of Slovenia. 4th contribution: Polyphaga: Scarabaeoidea (= Lamellicornia). *Scopolia* 70: 1–386. [in Slovenian and English] <http://www2.pms-lj.si/pdf/Scopolia/Scopolia-70.pdf>
- Britton EB (1956) Handbooks for the Identification of British Insects. Vol. V, Part 11. Coleoptera Scarabaeoidea (Lucanidae, Trogidae, Geotrupidae, Scarabaeidae). Royal Entomological Society, London, 29 pp. https://www.royensoc.co.uk/sites/default/files/Vol05_Part11_ed1.pdf
- Brustel H, Gouix N (2012) La chasse aux mythes! Petite contribution cryptoentomologique sur les Coléoptères de la Directive Habitats à rechercher en France. *Le Coléoptériste* 15(1): 26–37. https://inpn.mnhn.fr/fichesEspece/BRUSTEL_&_GOUIX_2012_especes_DHFF_a_rechercher.pdf
- Bunalski M (1999) Die Blatthornkäfer Mitteleuropas (Coleoptera, Scarabaeoidea). Bestimmung – Verbreitung – Ökologie. F. Slamka, Bratislava, 80 pp.
- Bunalski M (2001) Checklist of Bulgarian Scarabaeoidea (Coleoptera). Fourth contribution to the knowledge of Scarabaeoidea of Bulgaria. *Polskie Pismo Entomologiczne* 70: 165–172.
- Bunalski M, Sienkiewicz P, Kubasik W, Konwerski S, Pałka K (2013) Materiały do poznania rozmieszczenia chrząszczy (Coleoptera) Zachodniej Polski. Część 4. Bolboceratidae. (Contribution to the knowledge of beetles (Coleoptera) distribution in Western Poland. Part 4. Bolboceratidae). *Wiadomości Entomologiczne* 32: 259–265. [in Polish with English abstract] http://pte.au.poznan.pl/we/2013/35_Bunalski_I_in.pdf
- Burakowski B, Mroczkowski M, Stefańska J (1983) Katalog Fauny Polski. Catalogus faunae Poloniae. Część XXIII, tom 9. Chrząszcze – Coleoptera. Scarabaeoidea, Dascilloidea, Byrrhoidea, Parnoidea. Nr. 38 «Katalogu fauny Polski». [Catalogue of the fauna of Poland. Catalogus faunae Poloniae. Part XXIII, Volume 9. Beetles – Coleoptera. Scarabaeoidea, Dascilloidea, Byrrhoidea, Parnoidea. No. 38 of the “Catalogue of the fauna of Poland”]. Państwowe Wydawnictwo Naukowe, Warsaw, 294 pp. [in Polish]
- Byk A, Mokrzycki T, Dworakowski M, Bidas M (2012) Rozmieszczenie *Odonteus armiger* (Scopoli, 1772) (Coleoptera: Scarabaeoidea: Bolboceratidae) w Polsce z uwagami o jego bionomii. *Odonteus armiger* (Scopoli, 1772) (Coleoptera: Scarabaeoidea: Bolboceratidae) in Poland with some bionomical data. *Wiadomości Entomologiczne* 31: 100–112. [in Polish with English abstract] http://pte.au.poznan.pl/we/2012/11_byk_i_in.pdf
- Byk A, Mokrzycki T, Rosa-Gruszecka A, Tylkowski S, Zamojski M (2016) Grzybolcowate (Bolboceratidae) i wygonakowate (Ochodaeidae) – aktywność, wymagania ekologiczne i metody obserwacji. (Bolboceratidae and Ochodaeidae – activity, ecological requirements and methods of observation). *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej w Rogowie* 18: 124–141. [in Polish with English abstract] http://cepl.sggw.pl/sim/pdf/sim49A_pdf/Byk_i_inni.pdf
- Caillol H (1913) Catalogue des Coléoptères de Provence. Deuxième partie. Société Linnéenne de Provence, Marseille, 607 pp.

- Callot H (2018) Liste de référence des Coléoptères d'Alsace. Version du 30-IX-2018. Société Alsacienne d'Entomologie, Strasbourg, 107 pp. http://soc.als.entomo.free.fr/Documents%20PDF/Liste_de_Reference_des_Coleopteres_Alsace_SAE_CALLOT.pdf [accessed 20 January 2021]
- Calwer CG (1858) Käferbuch. Allgemeine und specielle Naturgeschichte der Käfer Europa's. Nebst der Anweisung sie zu sammeln und aufzubewahren. Mit 1 schwarzen und 48 colorirten Tafeln. Krais & Hoffmann, Stuttgart, xxviii + 788 pp. + 49 pls. <https://books.google.cz/books?id=dTTPAAAAMAAJ&hl=cs&pg=PP1#v=onepage&q&f=false>
- Carpaneto GM, Piattella E (1995) Coleoptera Polyphaga V (Lucanoidea, Scarabaeoidea). Checklist delle Specie della Fauna Italiana 50: 1–18. <https://doi.org/10.21426/B618110438>
- Carpaneto GM, Piattella E, Pittino R (2000) The scarab beetles of Turkey: an updated checklist and chorotype analysis (Coleoptera, Scarabaeoidea). Biogeographia 21: 217–240. <https://doi.org/10.21426/B6110170>
- Carpaneto GM, Rovelli V, Bologna MA, Zapparoli M (2016) *Bolbelasmus unicornis* (Schrank, 1789). In: Stoch F, Genovesi P (Eds) Manuali per il monitoraggio di specie e habitat di interesse comunitario (Direttiva 92/43/CEE) in Italia: specie animali. Manuali e linee guida 141/2016. Istituto Superiore per la Protezione e la Ricerca Ambientale, Roma, 58–59. https://www.isprambiente.gov.it/public_files/direttiva-habitat/Manuale-141-2016.pdf
- Carpaneto GM, Ballerio A, Dellacasa M, Rey A, Uliana M, Ziani S (2021) Insecta: Coleoptera: Scarabaeoidea. In: Bologna MA, Zapparoli M, Oliverio M, Minelli A, Bonato L, Cianferoni F, Stoch F (Eds) Checklist of the Italian Fauna. Version 1.0. Last update: 2021-05-31. <https://www.lifewatchitaly.eu/iniziative/checklist-fauna-italia-it/checklist-table> [accessed 31 January 2022]
- Čepelák R (1925) Co jsem sbíral na Slovensku. [What I collected in Slovakia]. Acta Societatis Entomologicae Čechosloveniae 22: 110. [in Czech]
- Černecký J, Galvánková J, Považan R, Saxa A, Šeffer J, Šefferová V, Lasák R, Janák M (2014) Conservation status of habitats and species of Community interest in the period of 2007–2012 in the Slovak republic. Správa o stave biotopov a druhov európskeho významu za obdobie rokov 2007–2012 v Slovenskej republike. Štátna ochrana prírody Slovenskej republiky, Banská Bystrica, 1625 pp.
- Cherkunov N (1889) Spisok zhukov, vodyashchikhsya v Kiyeye i yego okrestnostyakh. Liste des coléoptères de Kiew et de ses environs. Zapiski Kiyevskago Obshchestva Yestestvoispytateley 10: 147–204. [in Russian with French title] <https://books.google.cz/books?id=4axHAQAAMAAJ&hl=cs&pg=RA1-PA147#v=onepage&q&f=false>
- Chimişliu C (2004) Taxonomie et nomenclature actualisées concernant les espèces des Scarabéoïdes (Insecta: Coleoptera: Scarabaeoidea) en Roumanie (à l'exclusion de la fam. des Lucanidae). Revue Roumaine de Biologie, Série de Biologie Animale 47: 31–41. <https://www.ibiol.ro/zoology/Volume%2047/Rev.%20roum.%20biol.%20-%20biol.%20anim.,%2047,%201-2,%202002.pdf>
- Chobot K, Mourek J (2008) Brouci. [Beetles]. In: Marhoul P, Turoňová D (Eds) Zásady managementu stanovišť druhů v evropsky významných lokalitách soustavy Natura 2000. [Guidelines for the management of the habitats of species in the Natura 2000 sites of European importance]. Agentura ochrany přírody a krajiny České Republiky, Prague, 65–80. [au-

- thors of the part related to *Bolbelasmus unicornis* (pp. 65–66): Kubáň V, Čížek L – Vítězslav Kubáň pers. comm.] [in Czech] <https://www.ochranaprirody.cz/res/archive/410/067755.pdf?seek=1544180725>
- Cosandey V, Chittaro Y, Sanchez A (2017) Liste commentée des Scarabaeoidea (Coleoptera) de Suisse. *Alpine Entomology* 1: 57–90. <https://doi.org/10.3897/alpento.1.21179>
- Costa A (1864) Acquisti fatti durante l'anno 1862. *Annuario del Museo Zoologico della Università di Napoli* 2: 8–94. <https://www.biodiversitylibrary.org/item/43418#page/12/mode/1up>
- Cristofori G de, Jan G (1832) Cataloghi sistematici e descrittivi degli oggetti di storia naturale esistenti nel museo di Giuseppe De Cristofori e Prof. Giorgio Jan contenenti il prodromo della fauna, della flora e della descrizione orittognostico-geognostica dell'Italia superiore. Sectio III.^a entomologia. Pars I.^a conspectus methodicus insectorum. Fasc. I.^{us} Coleoptera. Giovanni Pirotta, Milano, 3 + 111 + [2] + 16 pp. <https://doi.org/10.5962/bhl.title.59812>
- Cséfalvay R (2015) *Bolbelasmus unicornis* (Schränk, 1789) (Coleoptera, Geotrupidae). In: Janák M, Černecký J, Saxa A (Eds) Monitoring of animal species of Community interest in the Slovak Republic. Results and assessment in the period of 2013–2015. State Nature Conservancy of the Slovak Republic, Banská Bystrica, 26–27. https://daphne.sk/wp-content/uploads/2013/12/monitoring_zooANGL_web.pdf
- Csiki E (1904) Biztos adatok madaraink táplálkozásáról. Positive Daten über die Nahrung unserer Vögel. *Aquila* 11: 270–317. [in Hungarian and German] <https://www.biodiversitylibrary.org/item/87516#page/294/mode/1up>
- Csiki E (1905) Biztos adatok madaraink táplálkozásáról. 2. közlemény. Positive Daten über die Nahrung unserer Vögel. 2. Mitteilung. *Aquila* 12: 312–330. [in Hungarian and German] <https://www.biodiversitylibrary.org/item/87336#page/388/mode/1up>
- Csiki E (1910) Biztos adatok madaraink táplálkozásáról. Hetedik közlemény. Positive Daten über die Nahrung unserer Vögel. Siebente Mitteilung. *Aquila* 17: 205–218. [in Hungarian and German] <https://www.biodiversitylibrary.org/item/81097#page/235/mode/1up>
- Ćurčić SB, Pavićević D, Radović D, Vesović N, Bekchiev R, Ćurčić N, Guéorguiev B (2019) Current and predicted distribution of the rare and threatened beetle *Bolbelasmus (Bolbelasmus) unicornis* (Coleoptera: Geotrupidae) in Serbia. *European Journal of Entomology* 116: 413–424. <https://doi.org/10.14411/eje.2019.042>
- Curtis J (1829a) British entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland: containing coloured figures from nature of the most rare and beautiful species, and in many instances of the plants upon which they are found. Vol. VI [of 16]. London, pls 242–289 + text. <https://doi.org/10.5962/t.171559> [here arrangement by systematics in eight volumes]
- Curtis J (1829b) A guide to an arrangement of British insects; being a catalogue of all the named species hitherto discovered in Great Britain and Ireland. [Part 1 of 8]. Richard Taylor, London, i–vi, cols 1–32.
- Curtis J (1837) A guide to an arrangement of British insects; being a catalogue of all the named species hitherto discovered in Great Britain and Ireland. Second edition, greatly enlar. ged. J. Pigot and Co., Sherwood and Co., & Simpkin and Marshall, London, vi pp. + 294 cols + [1] p. <https://doi.org/10.5962/bhl.title.46860>

- Dalla Torre KW von (1879) Die Käferfauna von Oberösterreich. Systematisches Verzeichnis der in Oberösterreich bisher beobachteten Käfer. Jahresberichte des Vereins für Naturkunde in Österreich ob der Enns zu Linz 10: 1–125. https://www.zobodat.at/pdf/VNode_0010_0001-0125.pdf
- Dejean PFMA (1821) Catalogue de la collection de coléoptères de M. le Baron Dejean. Crevot, Paris, viii + 136 + [2] pp. <https://doi.org/10.5962/bhl.title.11259>
- Dejean PFMA (1833) Catalogue des coléoptères de la collection de M. le Comte Dejean. [Livraison 2]. Méquignon-Marvis Père et Fils, Paris, pp. 97–176. <https://doi.org/10.5962/bhl.title.8771>
- Dejean PFMA (1836) Catalogue des coléoptères de la collection de M. le Comte Dejean. Troisième édition, revue, corrigée et augmentée. [Livraisons 1–4]. Méquignon-Marvis Père et Fils, Paris, xiv + 384 pp. <https://doi.org/10.5962/t.173109>
- Derjanschi V, Baban E, Calestru L, Stahi N, Țugulea C (2016) Catalogue of the N. Zubowsky entomological collection. Bons Offices, Chișinău, 296 pp.
- Dobiasch E (1911) Käfer [advertisement for the sale of beetles]. Insekten-Börse 28: 363. <https://www.biodiversitylibrary.org/item/47736#page/361/mode/1up>
- Dostal A (2019) Verbreitung des Einhorn-Trüffelskäfers *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera: Geotrupidae) in der Wiener Lobau. Wien, 12 pp. [unpublished report for Municipal Department 22 – Environmental Protection, Vienna] <https://www.digital.wienbibliothek.at/wbrup/content/pageview/3292062> [accessed 2 December 2020]
- Dostal A, Barries W (2019) Wiederfund des Einhorn-Trüffelskäfers, *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera: Geotrupidae), in Niederösterreich. Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen 71: 7–11. http://www.entomologie.at/uploads/www.entomologie.at/71_2009_007-0011_dostal_barries_bolbelasmus.pdf
- Dostal A, Barries W (2021) *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera: Geotrupidae): Wiederfunde im Burgenland nach 39 Jahren. Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen 73: 31–35.
- Dostal A, Barries W, Brojer M, Fuchs K, Gross H, Hovorka W, Jäch MA, Link A, Ockermüller E, Schernhammer T (2021a) Bemerkenswerte Käferfunde aus Wien (Österreich) (I) (Coleoptera). Koleopterologische Rundschau 91: 279–302. https://www.zobodat.at/pdf/KOR_91_2021_0279-0302.pdf
- Dostal A, Barries W, Gross H, Fuchs K (2021b) Zur Verbreitung des Einhorn-Trüffelskäfers *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera: Geotrupidae) in der Wiener Lobau. Beiträge zur Entomofaunistik 22: 189–199.
- Duftschnid CE (1805) Fauna Austriæ, oder Beschreibung der österreichischen Insekten für angehende Freunde der Entomologie. Erster Theil. Akademie Buchhandlung, Linz und Leipzig, xxxvi + 37–311 + [4] pp. <https://doi.org/10.5962/bhl.title.65994>
- Duna-Ipoly National Park (2021) *Bolbelasmus unicornis* occurrence data. University of Debrecen, Debrecen. <https://doi.org/10.48428/ADATTAR/PBMKUZ> [accessed 15 December 2021]
- Eichwald KE von (1830) Zoologia specialis quam expositis animalibus tum vivis, tum fossilibus potissimum Rossiae in universum, et Poloniae in specie, in usum lectionum publicarum in Universitate Caesarea Vilnensi habendarum. Pars altera, specialem podozoorum expositionem continens. Joseph Zawadzki, Vilnius, 314 pp. + 5 pls. <https://doi.org/10.5962/bhl.title.51803>

- Eichardt J, Kutasi Cs (2011) Oroszlány a Vértes ölelésében. Oroszlány: a Town embraced by the Vértes. Tatabányai Múzeum Évkönyve 2: 5–35. [in Hungarian with English abstract] https://library.hungaricana.hu/en/view/MEGY_KOME_TataBanyaiMuzeum_EK_02/?pg=6&layout=s
- Endrődi S (1956) Lemezescsápú bogarak – Lamellicornia. Coleoptera IV. Magyarország Állatvilága 12. IX. kötet. 4. füzet. [Lamellicorn beetles – Lamellicornia. Coleoptera IV. Fauna Hungariae 12. IX. part, 4. issue]. Akadémiai Kiadó, Budapest, 188 pp. [in Hungarian]
- Endrődi S (1957) A lemezescsápú bogarak (Lamellicornia) kárpátmedencei lelőhelyadatai. [Faunistic data on Lamellicornia of the Carpathian Basin]. Folia Entomologica Hungarica 10: 145–226. [in Hungarian] https://library.hungaricana.hu/hu/view/FoliaEntomologica_1957_10_01_12/?pg=146&layout=s
- Endrődi S (1979) A Börzsöny-hegység bogárfaunája VII. Lamellicornia. (The beetle fauna of the Mts. Börzsöny. VII. Lamellicornia). Folia Historico-Naturalia Musei Matraensis 5: 25–37. [in Hungarian with English abstract] <https://matramuzeum.nhmus.hu/sites/default/files/nhmusfiles/kiadvanyok/foia/vol5/27-39.pdf>
- Enyedi R (2006) Contributions to the Scarabaeoidea fauna of Hungary (Coleoptera: Scarabaeoidea). Folia Historico-Naturalia Musei Matraensis 30: 215–225. https://matramuzeum.nhmus.hu/sites/default/files/nhmusfiles/kiadvanyok/foia/vol30/215_225Matra.pdf
- Enyedi R, Ádám L (2009) A Mátra Múzeum bogárgyűjteménye, Scarabaeoidea (Coleoptera). Collection of beetles of the Mátra Museum, Scarabaeoidea (Coleoptera). Folia Historico-naturalia Musei Matraensis 33: 133–155. [in Hungarian with English abstract] https://matramuzeum.nhmus.hu/sites/default/files/nhmusfiles/kiadvanyok/foia/vol33/13_Enyedi_Adam_Scarabaeoidea.pdf
- Erichson WF (1847) Naturgeschichte der Insecten Deutschlands. Erste Abtheilung. Coleoptera. Dritter Band. Nicolaische Buchhandlung, Berlin, 641–800. <https://doi.org/10.5962/bhl.title.8270>
- Fabre J-HC (1900) Souvenirs Entomologiques (septième série). Études sur l'instinct et les Mœurs des Insectes. Librairie Ch. Delagrave, Paris, 394 + [2] pp. <https://doi.org/10.5962/bhl.title.1403>
- Fabre J-HC (1907) Souvenirs Entomologiques (dixième série). Études sur l'instinct et les Mœurs des Insectes. Librairie Ch. Delagrave, Paris, 353 + [2] pp. <https://doi.org/10.5962/bhl.title.1403>
- Fabre J-HC (1920) Mœurs des Insectes. Morceaux choisis. Extraits des Souvenirs Entomologiques. 16 planches hors texte d'après les photographies de Paul-H. Fabre. Librairie Delagrave, Paris, pp. + 16 pls. http://www.rcin.org.pl/Content/49142/WA488_3920_1374_Fabre-Moeurs.pdf
- Fabricius JCh (1781) Species insectorum exhibentes eorum differentias specificas, synonyma auctorum, loca natalia, metamorphosin adiectis observationibus, descriptionibus. Tomus I. Carl Ernst Bohn, Hamburg – Kiel, viii + 552 pp. <https://doi.org/10.5962/bhl.title.36509>
- Fleck E (1905) Die Coleopteren Rumäniens (Fortsetzung). Buletinul Societății de Științe din București – România 14(1–2): 158–203. <https://www.biodiversitylibrary.org/item/105609#page/164/mode/1up>
- Fleischer A (1930) Přehled brouků fauny Československé republiky. [Overview of beetle fauna of the Czechoslovak Republic]. Moravské museum zemské, Brno, 485 pp. [in Czech]

- Fowler WW (1890) The Coleoptera of the British Islands. A descriptive account of the families, genera, and species indigenous to Great Britain and Ireland, with notes as to localities, habitats, etc. Vol. IV. Lamellicornia-Serricornia-Longicornia-Phytophaga. L. Reeve & Co., London, 411 pp. + pls 99–142. <https://doi.org/10.5962/bhl.title.14423>
- Frank J, Konzelmann E (2002) Die Käfer Baden-Württembergs 1950–2000. Landesamt für Umweltschutz Baden-Württemberg, Karlsruhe, 521 pp. http://publikationen.ub.uni-frankfurt.de/files/12233/kaefer_1950_2000.pdf
- Franz H (1936) Die thermophilen Elemente der mitteleuropäischen Fauna und ihre Beeinflussung durch die Klimaschwankungen der Quartärzeit. *Zoogeographica* 3: 159–320.
- Franz H (1974) Die Nordost-Alpen im Spiegel ihrer Landtierwelt. Eine Gebietsmonographie. Band IV. Universitätsverlag Wagner, Innsbruck – München, 707 pp.
- Frivaldszky I (1865) Jellemző adatok Magyarország faunájához. [Typical elements of the Hungarian fauna]. *A Magyar Tudományos Akadémia Évkönyve* 11(4): 1–274 + [1] + 13 pls. [in Hungarian] https://adt.arcanum.com/en/view/MTA_MagyarTudomanyosAkademiaEvkonyvei_011_1864-1869/?pg=84&layout=s
- Frivaldszky J (1879a) Insecta, Rovarok. Budapest s környékének jellemző rovarfajai. [Insecta, Insects. Insect species typical of the surroundings of Budapest]. In: Gerlőczy G, Dulácska G (Eds) Budapest és környéke természetrajzi, orvosi és közmívelődési leírása. [Description of the natural history, medicine and public education of Budapest and its surroundings]. *A Magyar Királyi Egyetemi Könyvnyomda*, Budapest, 337–403. [in Hungarian] <https://doi.org/10.5962/bhl.title.95630>
- Frivaldszky J (1879b) Insecta, Rovarok. Budapest s környékének jellemző rovarfajai. [Insecta, Insects. Insect species typical of the surroundings of Budapest]. In: Tivadar M (Ed.) Budapest és környéke állattani tekintetben. A budapesti fauna általános jellemzése s rövid rendszeres átnézete, a fajok lelhelyeivel és azokra vonatkozó jegyzetekkel. [Budapest and surroundings in terms of zoology. A general characterization and a brief systematic review of the fauna of Budapest, with the localities of the species and notes on them]. *A Magyar Királyi Egyetemi Könyvnyomda*, Budapest, 45–111. [in Hungarian] https://adt.arcanum.com/en/view/Books_22_OrvoslasTermeszetrjz_1280_Budapest_es_kornyeke_allattani_tekintetben_1088/?pg=44&layout=s
- Fröhlich C (1897) Beiträge zur Fauna von Aschaffenburg und Umgegend. Die Käfer. III. Mitteilung des naturwissenschaftlichen Vereines Aschaffenburg. Gustav Fischer, Jena, vii + 158 pp.
- Fuss C (1858) Beitrag zur Käferfauna Siebenbürgens. *Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt* 9(1): 4–7. <https://www.biodiversitylibrary.org/item/42663#page/16/mode/1up>
- Fusu L, Stan M, Dascălu M-M (2015) Coleoptera. In: Iorgu IȘ (Ed.) Ghid sintetic pentru monitorizarea speciilor de nevertebrate de interes comunitar din România. [Summary guide for monitoring invertebrate species of community interest in Romania]. *Asocierea S.C. Compania de Consultanță și Asistență Tehnică S.R.L. & S.C. Integra Trading S.R.L.*, București, 44–62. [in Romanian] http://www.crayfish.ro/anexe/ghid_sintetic_monitorizare_nevertebrate.pdf
- Gajdoš P, Majzlan O (2018) Pavúky (Araneae) a chrobáky (Coleoptera) lokality Lackovce – Velký vrch pri Humennom. [Spiders (Araneae) and beetles (Coleoptera) of the locality

- Lackovce – Veľký vrch near Humenné]. Entomofauna Carpathica 30(1): 25–41. [in Slovak with English abstract] http://www.ses.entomology.sk/entomofaunacarpatica/pdf/volume30/30_1_03_Gajdos_a_Majzlan_ec.pdf
- Gangloff L (1991) Catalogue et Atlas des Coléoptères d'Alsace. Tome 4. Lamellicornia – Scarabaeidae, Lucanidae. Société Alsacienne d'Entomologie & Musée zoologique de l'université et de la ville de Strasbourg, 106 pp.
- Gaskó B (2008) Csongrád megye természetes és természetközeli élőhelyeinek védelméről 1. Adatok az M5-ös autópálya nyomvonaláról és Szeged tágabb környékétől. [On the protection of natural and semi-natural habitats of Csongrád County 1. Data on the route of the M5 highway and the wider surroundings of Szeged]. A Móra Ferenc Múzeum Évkönyve, Természettudományi Tanulmányok (Studia Naturalia) 4: 1–394. [in Hungarian] https://library.hungaricana.hu/hu/view/MEGY_CSON_EK_Sn_04/?pg=6&layout=s
- Gaubil J (1849) Catalogue synonymique des Coléoptères d'Europe et d'Algérie. Maison, Paris. 296 + [1] pp. <https://doi.org/10.5962/bhl.title.53812>
- Gavrilović B, Stojanović D (2008) The Scarabaeidae (Coleoptera, Insecta) of Mount Fruška Gora. In: Ćurčić SB (Ed.) The Diversity of Coleoptera of the Fruška Gora National Park. Part One. Fruška Gora National Park & Directorate of Forests, Ministry of Agriculture, Forestry, and Water Management of the Republic of Serbia, Novi Sad, 89–105.
- Geiser R (1984) Überblick über den gegenwärtigen Stand der faunistisch-ökologischen Erfassung der Käfer Bayerns (Coleoptera). Mitteilungen der Münchner Entomologischen Gesellschaft 74: 129–154. https://www.zobodat.at/pdf/MittMuenchEntGes_074_0129-0154.pdf
- Gemminger M, Harold E von (1869) Catalogus Coleopterorum hucusque descriptorum synonymicus et systematicus. Tom. IV. Scarabaeidae. E. H. Gummi, München, 979–1346 + [8] pp. <https://doi.org/10.5962/bhl.title.9089>
- Gerstaecker CEA (1863) Arthropoda. In: Peters WCH, Carus JV, Gerstaecker CEA (Eds) Handbuch der Zoologie. Zweiter Band. Arthropoden bearbeitet von A. Gerstaecker. Rad-erthiere, Würmer, Echinodermen, Coelenteraten und Protozoen bearbeitet von J. Victor Carus. Wilhelm Engelmann, Leipzig, 421 pp. <https://doi.org/10.5962/bhl.title.105872>
- Ghiliani V (1847) Mémoire sur la station de quelques Coléoptères dans les différentes régions du Piémont. Annales de la Société Entomologique de France, Deuxième Série 5: 83–142. <https://www.biodiversitylibrary.org/item/34170#page/89/mode/1up>
- Ghiliani V (1887) Elenco delle specie di Coleotteri trovate in Piemonte. Annali della Accademia d'Agricoltura di Torino 29[=1886]: 195–381. https://archive.org/details/mil0112518_to0323_30_0000000/page/195
- Gimpl G, Lambropoulos M, Frank G, Steiner H, Heilingbrunner G (2020) Handbuch NATURA 2000.Wald. Naturnahe Waldbewirtschaftung für ausgewählte FFH-Schutzgüter im Wald. Schwerpunkt Arten. Kuratorium Wald, Wien, 144 pp. http://natura2000.wald.or.at/wp-content/uploads/2020/10/KuratoriumWald_Natura2000_Arten_2020_web.pdf
- Glerean P, Stefani G (2019) Una nuova popolazione di *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera, Geotrupidae) in Friuli Venezia Giulia (Italia nord-orientale). Gortania. Atti del Museo Friulano di Storia Naturale Botanica Zoologica 41: 51–62. http://www.civ-icimuseiudine.it/images/MFSN/Gortania/Gortania_41/G41_BZ_06-Glerean-Stefani.pdf

- Glerean P, Ragazzino L, Ballerio A (2021) Elusive but still present in Italy: two new populations of *Bolbelasmus unicornis* (Schrank) for northern Italy. Session V. Faunistics, biogeography and conservation. XXVI Italian National Congress of Entomology, 7–11 June 2021, Torino, 83–83. [poster] https://www.cnie2020.com/wp-content/uploads/2021/07/libro_abstract_Ita.pdf
- Gontarenko AV, Trach VA (2011) K faune plastinchatousykh zhukov (Coleoptera: Scarabaeoidea) Odesskoy i Nikolayevskoy oblastey. Contribution to the fauna of scarab beetles (Coleoptera: Scarabaeoidea) of the Odessa and Mykolayiv Regions. *Izvestiya Kharkovskogo Entomologicheskogo Obshchestva* 19(2): 20–22. [in Russian with English and Ukrainian abstracts]
- Gradojević ZM (1963) Naselja Arthropoda travnih zajednica Deliblatske peščare i njihova sukcesija. [Settlements of Arthropoda of the grass communities of the Deliblato Sands and their succession]. PhD Thesis, University of Belgrade, Belgrade, Serbia, 239 pp. [in Serbian]
- Gredler VM (1863) Die Käfer von Tirol nach ihrer horizontalen und vertikalen Verbreitung verzeichnet. J. Eberle, Bozen, iv + [1] + 491 pp. <https://www.digitale-sammlungen.de/de/view/bsb10307384?page=9>
- Guéorguiev BV, Bunalski M (2004) Critical Review of the Families Glaresidae, Lucanidae, Trogidae, Bolboceratidae, Geotrupidae, Hybosoridae and Ochodaeidae in Bulgaria (Coleoptera: Scarabaeoidea). *Acta Zoologica Bulgarica* 56(3): 253–275.
- Gutowski JM, Przewoźny M (2013) Program NATURA 2000 jako narzędzie ochrony chrząszczy (Coleoptera) w Polsce. *Natura 2000 as a tool to conserve beetles (Coleoptera) in Poland*. *Wiadomości Entomologiczne* 32(Supplementum): 5–40. [in Polish with English abstract] http://pte.au.poznan.pl/we/2013/supl_Gutowski_Przewozny.pdf
- Heer O (1841) Die Käfer der Schweiz, mit besonderer Berücksichtigung ihrer geographischen Verbreitung. Erster Theil, Dritte Lieferung [VI. Classe: Clavicornia, VII. Classe: Palpicornia, VIII. Classe: Lamellicornia]. *Neue Denkschriften der Allgemeinen Schweizerischen Gesellschaft für die Gesamten Naturwissenschaften* 5(4): 1–79. <https://www.biodiversitylibrary.org/item/39559#page/403/mode/1up>
- Heyden L von (1884) Coleopterologische Ausbeute des Baron H. v. Maltzan von der Insel Creta. *Deutsche Entomologische Zeitschrift* 28: 363–368. <https://www.biodiversitylibrary.org/page/33120005#page/367/mode/1up>
- Higurashi T, Tanahashi K (2014) Geotrupidae feeding on hypogeous fungi [in Japanese]. The 5th Annual Meeting of the Coleopterological Society of Japan. The Abstracts of Presentations 2014: 13.
- Higurashi T, Tanahashi K, Okuyama Yu (2019) Feeding behavior and lifecycle of mycophagous dung beetles feeding on arbuscular mycorrhizal sporocarps: possibility of spore dispersion by insects. Abstract of the 66th Annual Meeting of the Ecological Society of Japan, March 2019, Kobe. [in Japanese with English title] <https://www.esj.ne.jp/meeting/abst/66/W03-2.html> [accessed 1 July 2021]
- Hildt LF (1892) Przyczynek do fauny chrząszczów podolskich. [A contribution to the fauna of the beetles of Podolia]. *Pamiętnik Fizyograficzny* 12(3): 209–235. [in Polish] <https://www.biodiversitylibrary.org/item/172438#page/499/mode/1up>

- Hildt LF (1896) Żuki czyli gnojowce krajowe. [Beetles of the region]. Pamiętnik Fizyograficzny 14(3): 153–228. [in Polish] <https://www.biodiversitylibrary.org/item/150360#page/391/mode/1up>
- Hillert O, Arnone M, Král D, Massa B (2016) The genus *Bolbelasmus* in the western and southern regions of the Mediterranean Basin (Coleoptera: Geotrupidae: Bolboceratinae). Acta Entomologica Musei Nationalis Pragae 56(1): 211–254. https://www.aemnp.eu/data/article-1625/1606-56_1_211.pdf
- Hochhuth IH [= JH] (1873) Enumeration der in den russischen Gouvernements Kiew und Volhynien bisher aufgefundenen Käfer (Fortsetzung v. Bulletin 1872, N° 4). Bulletin de la Société Impériale des Naturalistes de Moscou 46(1): 124–164. <https://www.biodiversitylibrary.org/item/107118#page/130/mode/1up>
- Holdhaus K, Prossen T (1901) Verzeichnis der bisher in Kärnten beobachteten Käfer. Carinthia II 91: 92–106. https://www.zobodat.at/pdf/CAR_91_0092-0106.pdf
- Holzer E (2019) Erstnachweise und Wiederfunde für die Käferfauna der Steiermark (XVII) (Coleoptera). Joannea Zoologie 17: 149–170. https://www.zobodat.at/pdf/JoanZoo_17_0149-0170.pdf
- Horion A (1951) Verzeichnis der Käfer Mitteleuropas (Deutschland, Österreich, Tschechoslowakei) mit kurzen faunistischen Angaben. 2. Abteilung: Clavicornia, Terebrantia, Heteromera, Lamellicornia, Phytophaga, Rhynchophora. Alfred Kernen Verlag, Stuttgart, 277–536.
- Horion A (1957) Bemerkungen zur Scarabaeiden-Fauna von Südbayern. Nachrichtenblatt der Bayerischen Entomologen 11: 105–109. https://www.zobodat.at/pdf/NachBlBay-Ent_006_0105-0109.pdf
- Horion A (1958) Faunistik der Mitteleuropäischen Käfer. Band VI: Lamellicornia (Scarabaeidae – Lucanidae). A. Feyel, Überlingen – Bodensee, xxiv + 343 pp.
- Horváth G (1884) Egy múlt századbéli napló. [A diary from the last century]. Rovartani Lapok 1: 217–223. [in Hungarian] <https://www.biodiversitylibrary.org/item/103929#page/245/mode/1up>
- Horvatovich S (1980) Hazánk faunájára új és ritka bogárfajok a Dél- és Nyugat-Dunántúlról (Coleoptera) II. Für die Fauna Ungarns neue und seltene Käferarten aus Süd- und West-Transdanubien (Coleoptera) II. A Janus Pannonius Múzeum Évkönyve 24: 33–43. [in Hungarian with English abstract and German summary] https://library.hungaricana.hu/hu/view/MEGY_BARA_JPM_evkonyv_1979/?pg=34&clayout=s
- Houston TF (2011) Egg gigantism in some Australian earth-borer beetles (Coleoptera: Geotrupidae: Bolboceratinae) and its apparent association with reduction or elimination of larval feeding. Australian Journal of Entomology 50(2): 164–173. <https://doi.org/10.1111/j.1440-6055.2010.00794.x>
- Houston TF (2016) Brood cells, life-cycle stages and development of some earth-borer beetles in the genera *Bolborhachium*, *Blackburnium* and *Bolboleus* (Coleoptera: Geotrupidae), with notes on captive rearing and a discussion of larval diet. Austral Entomology 55(1): 49–62. <https://doi.org/10.1111/aen.12151>
- Houston TF, Bougher NL (2010) Records of hypogeous mycorrhizal fungi in the diet of some Western Australian bolboceratine beetles (Coleoptera: Geotrupidae, Bolboceratinae). Australian Journal of Entomology 49(1): 49–55. <https://doi.org/10.1111/j.1440-6055.2009.00720.x>

- Howden HF (1955) Biology and taxonomy of the North American beetles of the subfamily Geotrupinae with revisions of the genera *Bolbocerosoma*, *Eucanthus*, *Geotrupes* and *Peltotrupes*. Proceedings of the United States National Museum 104: 151–319. <https://doi.org/10.5479/si.00963801.104-3342.151>
- Howden HF (1964) The Geotrupinae of North and Central America. Memoirs of the Entomological Society of Canada 96(Supplement 39): 1–91. <https://doi.org/10.4039/entm9639fv>
- Howden HF (1985) A revision of the Australian beetle genera *Bolboleaus* Howden & Cooper, *Blackbolbus* Howden & Cooper, and *Bolborhachium* Boucomont (Scarabaeidae: Geotrupinae). Australian Journal of Zoology, Supplementary Series 111: 1–179. <https://doi.org/10.1071/AJZS111>
- Howden HF (2003) Subfamilia Geotrupinae. In: Morón MA (Ed.) Atlas de los escarabajos de México. Coleoptera: Lamellicornia. Vol. II. Familias Scarabaeidae, Trogidae, Passalidae y Lucanidae. Argania editio, Barcelona, 102–106.
- Howden HF, Cooper JB (1977) The generic classification of the Bolboceratini of the Australian region, with descriptions of four new genera (Scarabaeidae: Geotrupinae). Australian Journal of Zoology, Supplementary Series 50: 1–50. <https://doi.org/10.1071/AJZS050>
- Howden HF, Howden A, Holloway G (2007) Digging down under: Australian Bolboceratini, their habits and a list of species (Coleoptera: Scarabaeoidea: Geotrupidae). Zootaxa 1499(1): 47–59. <https://doi.org/10.11646/zootaxa.1499.1.2>
- Huber A (1916) Die wärmeliebende Tierwelt der weiteren Umgebung Basels. Archiv für Naturgeschichte 82(7): 1–120. <https://www.biodiversitylibrary.org/item/47768#page/351/mode/1up>
- Huchet J-B, Azoulay L, Danay O, Ezov N, Perman I, Friedman A-L, Shaltiel-Harpaz L (2022) *Ochodaeus berytensis* Petrovitz (Coleoptera: Ochodaeidae), a new pest of the truffle *Tuber aestivum* in Upper Galilee, Israel. Journal of Applied Entomology 00: 1–6. <https://doi.org/10.1111/jen.13027>
- Hudeček L (1928) Entomologie (Motýlové, brouci, mřížokřídlí, rovnokřídlí, sítokřídlí, polokřídlí). Zvláštní otisk z „Vlastivědy župy olomoucké“. [Entomology (Lepidoptera, Coleoptera, Pseudoneuroptera, Orthoptera, Neuroptera, Hemiptera). Special print from “Natural History of the Olomouc County”]. J. Slovák, Kroměříž, 48 pp. [in Czech]
- Hudeček L (1930) Entomologie. Brouci – Coleoptera. [Entomology. Beetles – Coleoptera]. In: Černý N, Pelíšek R (Eds) Vlastivěda střední a severní Moravy. Vlastivěda župy olomoucké. Díl I. Přírodní památky střední a severní Moravy. Vlastivědné příručky. Svazek I. [Natural history of Central and Northern Moravia. Natural history of the Olomouc County. Part I. Natural monuments of Central and Northern Moravia. Natural history guides. Volume I.]. Vydavatelství sdružení učitelstva župy olomoucké, Kroměříž, 360–376. [in Czech]
- Hudeček L (1937) Jižní a jiné vzácné druhy hmyzu, pozorované ve střední a severní Moravě. [Southern and other rare species of insects, observed in central and northern Moravia]. Časopis Vlasteneckého Spolku Musejního v Olomouci 50: 151–153. [in Czech]
- Hůrka K (2005) Brouci České a Slovenské republiky. Beetles of the Czech and Slovak Republics. Nakladatelství Kabourek, Zlín, 390 pp. [in Czech and English]

- Ihssen G (1935) Beiträge zur Kenntnis der Fauna von Südbayern (3). Entomologische Blätter 31(2): 42–48.
- Illiger JKW (1798) Verzeichniss der Käfer Preussens. Entworfen von Johann Gottlieb Kugelann Apotheker in Osterode. Ausgearbeitet von Johann Karl Wilhelm Illiger. Mit einer Vorrede des Professors und Pagenhofmeisters Hellwig in Braunschweig, und dem angehängten Versuche einer natürlichen Ordnungs- und Gattungs-Folge der Insekten. Johann Jacob Gebauer, Halle, xlii + [1] + 510 + [1] pp. <https://doi.org/10.5962/bhl.title.125071>
- Illiger JKW (1800) Olivier's Entomologie oder Naturgeschichte der Insekten mit ihren Gattungs- und Artmerkmalen, ihrer Beschreibung und Synonymie. Käfer. Uebersetzt und mit Zusätzen und Anmerkungen durchgängig begleitet. Erster Theil. Karl Reichard, Braunschweig, xvi + 309 pp. + 2 pls. <https://doi.org/10.5962/bhl.title.120818>
- Jäch MA, Adlbauer K, Barries W, Cate P, Franz H, Geiser E, Geiser R, Holschuh C, Kirschenhofer E, Kreissl E, Novak G, Probst J, Reiser P, Schillhammer H, Schmid H, Schödl S, Suppantitsch W, Wewalka G, Zábanský P, Zelenka W (1994) Rote Liste der gefährdeten Käfer Österreichs (Coleoptera). Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie 2: 107–200. https://www.zobodat.at/pdf/Gruene-Reihe-Lebensministerium_2_0107-0200.pdf
- Jacquelin du Val PNC (1863) Catalogue de la famille des scarabéides. In: Jacquelin du Val PNC, Fairmaire L, Migneaux J (Eds) Manuel Entomologique. Genera des Coléoptères d'Europe comprenant leur classification en familles naturelles, la description de tous les genres, des Tableaux synoptiques destinés à faciliter l'étude, le Catalogue de toutes les espèces, de nombreux dessins au trait de caractères et plus de quinze cents types représentant un ou plusieurs insectes de chaque genre dessinés et peints d'après nature avec le plus grand soin. Tome troisième. A. Deyrolle, Paris [1859–1863], 126–138. <https://doi.org/10.5962/bhl.title.35866>
- Jäger G (1884) C. G. Calwers Käferbuch. Naturgeschichte der Käfer Europas zum Handgebrauche für Sammler. Julius Hoffmann & K. Thienemann, Stuttgart, [2] + lvi + 667 + [1] pp. + 50 pls. <https://doi.org/10.5962/bhl.title.66959>
- Jameson ML (2002) Family 29. Geotrupidae Latreille 1802. In: Arnett Jr RH, Thomas MC, Skelley PE, Frank JH (Eds) American Beetles. Volume 2. Polyphaga: Scarabaeoidea through Curculionoidea. CRC Press, Boca Raton, 23–27. <https://doi.org/10.1201/9781420041231>
- Jasilkowski SB (1906) Weitere Coleopterenfunde aus der Bukowina (Fortsetzung). Insekten-Börse 23: 87–88. <https://www.biodiversitylibrary.org/page/43817504>
- Jessop L (1986) Handbooks for the Identification of British Insects. Vol. 5, Part 11. Dung Beetles and Chafers Coleoptera: Scarabaeoidea. New edition. Royal Entomological Society, London, 53 pp. https://www.royensoc.co.uk/sites/default/files/Vol05_Part11.pdf
- Joy NH (1932) A Practical Handbook of British Beetles. Volume 1. H. F. & G. Witherby, London, xxvii + 622 pp.
- Jungwirth D (2005) Kommentierte Checkliste der Lamellicornia Bayerns (Coleoptera, Scarabaeoidea). Facetta 23–24: 28–44. https://www.zobodat.at/pdf/Facetta_23-24_0028-0044.pdf
- Jungwirth D (2012) Die Blatthornkäfer des Naturmuseums Augsburg (Insecta, Coleoptera, Lamellicornia). Bericht der Naturforschenden Gesellschaft Augsburg 64: 32–55. https://www.zobodat.at/pdf/Ber-Naturf-Ges-Augsburg_064_2012_0032-0055.pdf

- Juřena D, Týr V (2008) Seznam listorohých brouků (Coleoptera: Scarabaeoidea) České republiky a Slovenska. Checklist of Scarabaeoidea (Coleoptera) of the Czech Republic and Slovakia. Klapalekiana 44(Supplementum): 3–15. [in Czech with English abstract and summary]
- Juřena D, Týr V, Bezděk A (2008) Příspěvek k faunistickému výzkumu listorohých brouků (Coleoptera: Scarabaeoidea) na území České republiky a Slovenska. Contribution to the faunistic research on Scarabaeoidea (Coleoptera) in the Czech Republic and Slovakia. Klapalekiana 44(Supplementum): 17–176. [in Czech with English abstract and summary] <http://hdl.handle.net/11104/0177252>
- Kaděra M (2017) Chrobák jednorohý. [Earth-borer beetle *Bolbelasmus unicornis*]. Naše Příroda 2017(5): 24–27. [in Czech] <http://nasepriroda.cz/artkey/npr-201705-0003.php>
- Kahlen M (2018) Die Käfer von Südtirol. Ein Kompendium. Veröffentlichungen des Naturmuseum Südtirol. Nr. 13. Naturmuseum Südtirol, Bozen, 602 pp.
- Kampmann FE (1860) Catalogus Coléopterorum vallis rhenanæ alsatico-badensis. Bulletin de la Société d'Histoire Naturelle de Colmar 1: 29–75. <https://www.numistral.fr/ark:/12148/bpt6k9637896x/f33.item>
- Kaszab Z (1937) A Kőszegi hegység bogárfaunájának alapvetése. Grundlagen zur Kenntnis der Käferfauna des Kőszeg Gebirges. Vasi Szemle 4(3): 161–185 [A Kőszegi Múzeum Közleményei 1(2): 1–27]. [in Hungarian with German summary] http://real-j.mtak.hu/9652/1/MTA_DunantuliVasiSzemle_1937.pdf
- Kaufmann E (1897) Jellemző magyarországi Coleopterák. II. [Typical Hungarian Coleoptera. II.]. Rovartani Lapok 4: 151–153. [in Hungarian] <https://www.biodiversitylibrary.org/item/54389#page/19/mode/1up>
- Kaufmann E (1914a) Képek a Mecsek-hegység bogárvilágából. [Pictures from the beetle world of the Mecsek Mountains]. Különlenyomat a Mecsek Egyesület 1913-iki évkönyvéből [Special print from the 1913 yearbook of the Mecsek Association], Pécs, 35 pp. [in Hungarian]
- Kaufmann E (1914b) Pécs város és Baranyavármegye bogárfaunája. [The beetle fauna of the city of Pécs and the Baranya County]. Pécs-Baranyamegyei Múzeum-Egyesület, Pécs, 94 pp. [in Hungarian]
- Kavurka VV, Zaika MI, Popov HV, Lazarev IYe (2019) Novi znakhidky pavukopodibnykh (Arachnida), bahatonizhok (Myriapoda) ta komakh (Insecta), zanesenykh do Chervonoi knyhy Ukrainy. [New records of arachnids (Arachnida), millipedes (Myriapoda) and insects (Insecta), listed in the Red Book of Ukraine]. In: Akimov IA, Kharchenko VO, Kostyushyn VA, Vasyliuk OV (Eds) Materialy do 4-ho vydannia Chervonoi knyhy Ukrainy. Tvarynnyi svit. Tom 3. [Materials for the 4th edn. of the Red Book of Ukraine. Fauna. Volume 3]. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine & Ukrainian Nature Conservation Group, Kyiv, 134–141. [in Ukrainian] https://pub.flowpaper.com/docs/http://uncg.org.ua/wp-content/uploads/2019/11/Mater.-do-ChKU_tvaryny-3_2019_compressed.pdf#page=135
- Keith D (2002) Contribution à la connaissance des Scarabaeoidea du Proche et du Moyen Orient (10^e note) sur la faune de Chypre. Biocosme Méditerranéen 19(1–2): 21–30.

- Kelecsényi K (1900) Ujabb adatok Nyitra megye bogár-faunájához. [New data on the beetle fauna of Nitra County]. A Nyitra vármegyei Orvos-Gyógyászerészeti és Természettudományi Egyesület Évkönyve 5[1897–1900]: 42–57. [in Hungarian]
- Kendi K (1910) Adatok Bosnyákország bogárfaunájához. [Data on the beetle fauna of Bosnia]. Rovartani Lapok 17: 6–12. [in Hungarian] <https://www.biodiversitylibrary.org/item/103059#page/414/mode/1up>
- Keve A, Szijj J (1957) Distribution, biologie et alimentation du Faucon kobez *Falco vespertinus* L. en Hongrie. Alauda 25(1): 1–23. <https://www.biodiversitylibrary.org/item/293533#page/5/mode/1up>
- Kittel G (1879) Systematische Uebersicht der Käfer, welche in Baiern und der nächsten Umgebung vorkommen. (Fortsetzung). Correspondenz-Blatt des Zoologisch-Mineralogischen Vereines in Regensburg 33: 39–40. <https://www.biodiversitylibrary.org/item/43470#page/45/mode/1up>
- Kiesenwetter EAH von, Schaum HR (1849) Catalogus coleopterorum Europae. Bautzen, 82 + [7] pp. <https://www.biodiversitylibrary.org/item/47880#page/5/mode/1up>
- Kliment J (1899) Čestí brouci. Dílo o broucích Čech, Moravy a Slezska. [Czech beetles. A study on beetles of Bohemia, Moravia and Silesia]. J. Kliment, Německý Brod, xvi + 811 pp. [in Czech] <https://kramerus5.nkp.cz/view/uuid:28e81840-2dc5-11de-a5a9-000d606f5dc6?page=uuid:96b33db0-e365-11e6-8010-005056827e51>
- Klug JChF (1843) Die Coleopteren-Gattungen: *Athyreus* und *Bolboceras*, dargestellt nach den in der Sammlung hiesiger Königl. Universität davon vorhandenen Arten. Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin 1843(1): 21–57 + pls 1–2. <https://www.biodiversitylibrary.org/item/92691#page/51/mode/1up>
- Knörzer A (1912) Deutschlands wärmste Gegenden und ihre Insektenfauna. Bulletin de la Société d'Histoire Naturelle de Colmar, Nouvelle Série 9: 1–24. <https://doi.org/10.5962/bhl.title.8778>
- Koča G (1906) Popis tvrdokrilaca (kornjaša) Vinkovačke okoline. Enumeratio coleopterorum circa Vinkovce inventorum. Glasnik Hrvatskoga Naravoslovnoga Društva 17: 119–212. [in Croatian] <https://www.biodiversitylibrary.org/item/42301#page/129/mode/1up>
- Koch K (1989) Die Käfer Mitteleuropas, Ökologie. Band 2. Goecke & Evers, Krefeld, 382 pp.
- Köhler F, Klausnitzer B (1998) Entomofauna Germanica. Band 1. Verzeichnis der Käfer Deutschlands. Entomologische Nachrichten und Berichte (Beiheft 4): 1–185.
- Koleška Z (1979) Seznam biografí československých entomologů (entomologové nežijící). I. Čepelák Rudolf. [Biographies of Czechoslovak entomologists (entomologists deceased). I. Čepelák Rudolf]. Zprávy Československé Společnosti Entomologické při ČSAV 15(Supplementum A): 25–26. [in Czech]
- Koleška Z (1981) Seznam biografí československých entomologů (entomologové nežijící). I. Pokračování 3. Hajný František. [Biographies of Czechoslovak entomologists (entomologists deceased). I. Part 3. Hajný František]. Zprávy Československé Společnosti Entomologické při ČSAV 17(Supplementum A): 84. [in Czech]
- Koleška Z (1985) Seznam biografí československých entomologů (entomologové nežijící). I. Pokračování 7. Kyselý Karel. [Biographies of Czechoslovak entomologists (entomologists deceased). I. Part 7. Kyselý Karel]. Zprávy Československé Společnosti Entomologické při ČSAV 21(Supplementum A): 236. [in Czech]

- Koleška Z (1995a) Seznam biografí československých entomologů (entomologové nežijící) – 15. pokračování. Šlégl František. [Biographies of Czechoslovak entomologists (entomologists deceased) – Part 15. Šlégl František]. Klapalekiana 31(Supplementum): 578. [in Czech]
- Koleška Z (1995b) Seznam biografí československých entomologů (entomologové nežijící) – 15. pokračování. Thurnher Václav, Ing. [Biographies of Czechoslovak entomologists (entomologists deceased) – Part 15. Thurnher Václav, Ing.] Klapalekiana 31(Supplementum): 623. [in Czech]
- Kollár L, Smetana V (1994) Skarabeusovitě (Coleoptera, Scarabaeidae) v zbírkách Tekovského múzea v Leviciach. (Scarab beetles (Coleoptera, Scarabaeidae) in the collections of Tekov museum in Levice). Acta Musei Tekoviensis Levice 2: 63–80. [in Slovak with English abstract] <https://www.muzeumlevice.sk/images/dokumenty/zborniky/Z2/z2-08-Kollar.pdf>
- Kolouch LR (2002) Kartografické čtverce – možnost jejich stanovení z mapových podkladů. Cartographic squares – possibility of their designation from maps. Malacologica Bohemoslovaca 1: 7–9. [in Czech with English summary] <https://doi.org/10.5817/MaB2002-1-7>
- Koren T (2017) The status and occurrence of *Bolbelasmus unicornis* Schrank, 1789 (Coleoptera: Geotrupidae) in Croatia. Acta Zoologica Bulgarica 69(1): 139–142. <https://www.acta-zoologica-bulgarica.eu/downloads/acta-zoologica-bulgarica/2017/69-1-139-142.pdf>
- Köteles L, Bakonyi G (1996) First record on the Scarabaeoidea (Coleoptera) fauna of Gödöllő (Hungary). Folia Entomologica Hungarica 57: 97–104. http://publication.nhmus.hu/pdf/foleentom/FoliaEntHung_1996_Vol_57_97.pdf
- Kovachev VT (1905) Prinosa kam izuchavaneto na entomologichnata fauna na Bulgaria. [Contribution to the study of the Bulgarian insect fauna]. Godishnik Rusenskata Gimnaziya 1904–1905: 3–12. [in Bulgarian]
- Kral H (1915) Die Käfer aus dem Gebiete des Kummergebirges. Mitteilungen aus dem Vereine der Naturfreunde in Reichenberg 42: 49–100.
- Král D (2006) Metodika monitoringu evropsky významného druhu chrobák jednorohý (*Bolbelasmus unicornis*). [Monitoring methods for earth-borer beetle *Bolbelasmus unicornis*, the species of European importance]. Agentura ochrany přírody a krajiny ČR, Prague, 7 pp. [in Czech]
- Král D, Malý V (1993) New records of Scarabaeoidea (Coleoptera) from Bulgaria. Acta Societatis Zoologicae Bohemicae 57: 17–29. <https://www.zoopol.cz/ixadmin/app/webroot/uploads/15-12-2017/1993/1993%201.pdf>
- Král D, Löbl I, Nikolajev GV (2006) Family Bolboceratidae Mulsant, 1842. In: Löbl I, Smetana A (Eds) Catalogue of Palearctic Coleoptera. Volume 3. Scarabaeoidea – Scirtoidea – Dascilloidea – Buprestoidea – Byrrhoidea. Apollo Books, Stenstrup, 82–84. <http://www.apollobooks.dk/palaearticcoleoptera.htm>
- Král D, Bezděk A, Juřena D (2018) Coleoptera: Scarabaeoidea: Geotrupidae, Trogidae, Glareidae, Lucanidae, Ochodaeidae, Glaphyridae. Icones insectorum Europae centralis. Folia Heyrovskyana. Serie B 32: 1–28. https://www.zin.ru/animalia/coleoptera/pdf/kral_bezdek_jurena_2018-icones.pdf
- Krell F-Th (1998) Familienreihe Lamellicornia. In: Lucht W, Klausnitzer B (Eds) Die Käfer Mitteleuropas 15 (4. Supplementband). Goecke & Evers, Krefeld, 285–295.

- Krikken J (1977) The genus *Bolbelasmus* Boucomont in Asia, with notes on species occurring in other regions (Coleoptera: Geotrupidae). *Zoologische Mededelingen* 51: 278–292. <https://repository.naturalis.nl/pub/319326/ZM1977051017.pdf>
- Krikken J (1979) The genus *Bolbocerosoma* Schaeffer in Asia (Coleoptera: Geotrupidae). *Zoologische Mededelingen* 54: 35–51. <https://repository.naturalis.nl/pub/318362/ZM1979054003.pdf>
- Krynicky I [= J] [= Krinitskiy IA] (1832) Enumeratio Coleopterorum Rossiae meridionalis et praecique in Universitatis Caesariae Charkoviensis circulo obvenientium, quae annorum 1827–1831 spatio observavit. *Bulletin de la Société Impériale des Naturalistes de Moscou* 5: 65–179 + pls ii–iii. <https://www.biodiversitylibrary.org/item/124268#page/71/mode/1up>
- Kubicka A (1981) Scarabaeids (Coleoptera, Scarabaeidae) of Warsaw and Mazovia. *Memorabilia Zoologica* 34: 145–164. <https://rcin.org.pl/dlibra/publication/25816/edition/36733/content>
- Kuhnt P (1912) *Illustrierte Bestimmungstabellen der Käfer Deutschlands. Ein Handbuch zum genauen und leichten Bestimmen aller in Deutschland vorkommenden Käfer. Mit 10 000, alle wichtigen Bestimmungsmerkmale illustrierenden Text-Abbildungen.* E. Schweizerbart'sche Verlagsbuchhandlung Nägele & Dr. Sproesser, Stuttgart, vii + 1138 pp.
- Kulikovskiy EA (1897) Materialy dlya fauny Coleoptera Yuzhnoy Rossii. Die Käferfauna v. Süd-Russlands. *Zapiski Novorossiyskago Obshchestva Yestestvoispytateley* 21: 1–278. [in Russian]
- Kuntze R, Noskiewicz J (1938) *Zarys zoogeografii polskiego Podola. Versuch einer Zoographie des polnischen Podoliens. Prace naukowe, dział II., tom IV.* Wydawnictwo Towarzystwa Naukowego we Lwowie, Lviv, vii + 538 pp. [in Polish with German summary] https://baza.biomap.pl/en/getpdf/4574_Kuntze_et_Noskiewicz_1938.pdf
- Kutasi Cs (2002) Védett bogarak (Coleoptera) a Vértes-hegységből és környékéről. [Protected beetles (Coleoptera) from the Vértes mountain range and its surroundings]. *Limes* 2002(1): 35–45. [in Hungarian] https://adt.arcanum.com/en/view/Limes_2002/?pg=238&layout=s
- Kuthy D (1898) *A Magyar birodalom állatvilága. A Magyar birodalomból eddig ismert állatok rendszeres lajstroma. Fauna regni Hungariae. Animalium Hungariae hucusque cognitorum enumeratio systematica. Editio separata. III. Arthropoda (Insecta, Coleoptera).* Királyi Magyar Természettudományi Társulat, Budapest, 213 pp. [in Hungarian and Latin] http://eprints.edk.oee.hu/534/1/hk_153_magyar_birodalom_allatvilaga_opt.pdf
- Laco [= Laczó] J (1928) Fauna chrobákov z okolia Bolešov-Piechova neďaleko Trenčína, Slovakia. Fauna Coleopterorum ex pagu Bolešov-Piechov prope Trenčín, Slovakia. In: Laco [= Laczó] J (Ed.) *Chrobákoveda. Vol. III. Popis nových chrobákov. Fauna chrobákov Slovenska, župy Trenčianskej, okolia Bratislavy a okolia Bolešov-Piechov.* [Coleopterology. Vol. III. Description of new beetles. Fauna of the beetles of Slovakia, the county of Trenčín, the vicinity of Bratislava and the vicinity of Bolešov-Piechov] Jozef Laco [= József Laczó] [litography], Bratislava, 1–35. [chapters paginated separately] [in Slovak and Latin] <https://sk.wikipedia.org/wiki/Chrob%C3%A1koveda>
- Lacordaire Th (1856) *Histoire naturelle des insectes. Genera des Coléoptères ou exposé méthodique et critique de tous les genres proposés jusqu'ici dans cet ordre d'insectes.* Tome

- troisième contenant les familles des Pectinicornes et Lamellicornes. Roret, Paris, 594 pp. <https://doi.org/10.5962/bhl.title.8864>
- Laczó J (1905) Kirándulás a bolessói erdőkben fekvő csepkőbarlanghoz. [Excursion to the stalactite cave in the Bolešov forests]. A Trencsén Vármegyei Természettudományi Egylet 27–28: 251–255. [in Hungarian]
- Lane SA, Mann DJ (2016) A review of the status of the beetles of Great Britain. The stag beetles, dor beetles, dung beetles, chafers and their allies – Lucanidae, Geotrupidae, Trogidae and Scarabaeidae. Species Status 31: 1–118. <http://publications.naturalengland.org.uk/file/6560814490714112>
- Lapini L, Dorigo L, Glerean P, Giovannelli MM (2013) Status di alcune specie protette dalla direttiva habitat 92/43/CEE nel Friuli Venezia Giulia (Invertebrati, Anfibi, Rettili, Mammiferi). Gortania. Atti del Museo Friulano di Storia Naturale Botanica Zoologica 35: 61–139. http://www.civicimuseiudine.it/images/MFSN/Gortania/Gortania%2035_BZ/GORT35%2061-139%20Lapini%20LR.pdf
- Laporte de Castelnau FLNC (1840) Histoire naturelle des insectes Coléoptères, avec une introduction renfermant l'anatomie et la physiologie des animaux articulés, par M. Brullé; ouvrage accompagné de 155 planches gravées sur acier représentant plus de 800 sujets. Tome deuxième. P. Duménil, Paris, 563 + [1] pp. + 38 pls. <https://doi.org/10.5962/bhl.title.35290>
- Lawrence JF, Newton Jr AF (1995) Families and subfamilies of Coleoptera (with selected genera, notes, references and data on family-group names). In: Pakaluk J, Ślipiński SA (Eds) Biology, Phylogeny, and Classification of Coleoptera: Papers Celebrating the 80th Birthday of Roy A. Crowson. Museum i Instytut Zoologii PAN, Warsaw, Poland, 779–1006. https://www.zin.ru/animalia/coleoptera/pdf/lawrence_newton_1995_families_and_subfamilies_coleoptera_part-1.pdf
- Lelo S (2006) Popis balegara (Insecta: Scarabaeoidea) Bosne i Hercegovine. Checklist of dung beetles (Insecta: Scarabaeoidea) of Bosnia and Herzegovina. Prilozi Fauni Bosne i Hercegovine 2: 8–31. [in Bosnian with English abstract] <http://faunabih.com/wp-content/uploads/2018/09/No.-002c.pdf>
- Lelo S, Kašić-Lelo M (2010) Biodiverzitet listorožaca (Insecta: Coleoptera: Scarabaeoidea) Bosne i Hercegovine. Biosistematski prijedlog podataka sa preliminarim kartama rasprostranjenja. [Biodiversity of scarab beetles (Insecta: Coleoptera: Scarabaeoidea) of Bosnia and Herzegovina. Biosystematic overview of data with preliminary distribution maps]. Udruženje za inventarizaciju i zaštitu životinja, Ilijaš, 70 pp. [in Bosnian]
- Link A, Mitter H, Ockermüller E, Hauser E 2011: Untersuchungen zum Vorkommen der beiden FFH-Arten *Bolbelasmus unicornis* (SCHRANK 1789) und *Cucujus cinnaberinus* (SCOPOLI 1763) im Natura 2000-Gebiet „Untere Traun“. Linz, 23 pp. [unpublished report for the Nature Conservation Department of Upper Austria, Linz]
- Löbl I, Löbl D (2016) References. In: Löbl I, Löbl D (Eds) Catalogue of Palearctic Coleoptera. Volume 3: Scarabaeoidea – Scirtoidea – Dascilloidea – Buprestoidea – Byrrhoidea. Revised and Updated Edition. Brill, Leiden & Boston, 627–961. https://doi.org/10.1163/9789004309142_004

- Lodos N, Önder F, Pehlivan E, Atalay R, Erkin E, Karsavuran Y, Tezcan S, Aksoy S (1999) Faunistic studies on Scarabaeoidea (Aphodiidae, Cetoniidae, Dynastidae, Geotrupidae, Glaphyridae, Hybosoridae, Melolonthidae, Ochodaeidae, Rutelidae, Scarabaeidae) (Coleoptera) of western Black Sea, central Anatolia and Mediterranean regions of Turkey. Department of Plant Protection, Faculty of Agriculture, University of Ege, İzmir, 63 pp.
- Łomnicki MA (1913) Wykaz chrząszczów czyli Tęgopokrywych (Coleoptera) ziem polskich. (Catalogus coleopterorum Poloniae). [List of beetles or coleopterans (Coleoptera) of Poland (Catalogus coleopterorum Poloniae)]. Kosmos 38: 21–155. [in Polish] https://baza.biomap.pl/en/getpdf/5282_Lomnicki_MA_1913.pdf
- Luigioni P (1929) I Coleotteri d'Italia. Catalogo sinonimico-topografico-bibliografico. Memorie della Pontificia Accademia delle Scienze – I Nuovi Lincei, Serie II 13: 1–1130.
- Lumaret J-P (1990) Atlas des Coléoptères Scarabéides Laparosticti de France. Série des Inventaires de Faune et de Flore 1: 1–419. https://bibliotheques.mnhn.fr/EXPLOITATION/infodoc/ged/viewportalpublished.ashx?eid=IFD_FICJOINT_IFAFL_S000_1980_T001_N000_1
- Machatschke JW (1969) Familienreihe Lamellicornia. In: Freude H, Harde KW, Lohse GA (Eds) Die Käfer Mitteleuropas, Band 8. Terebrantia, Heteromera, Lamellicornia. Goecke & Evers, Krefeld, 265–371.
- Madon P (1930) Pics, Grimpereaux, Sittelles, Huppes; leur régime (fin). Alauda, Série 1 2(3–4): 206–240. <https://www.biodiversitylibrary.org/item/291971#page/56/mode/1up>
- Majzlan O (2006) Faunistické príspevky zo Slovenska (Coleoptera) 2. Faunistic notes on beetles (Coleoptera) 2. from Slovakia. Naturae Tutela 10: 195–200. [in Slovak with English abstract] <http://www.ses.entomology.sk/prace/pdf-prace/fauna-2.pdf>
- Majzlan O (2007) Chrobáky (Coleoptera) PR Ostrov Kopáč pri Bratislave. Beetles (Coleoptera) of the Nature Reserve Ostrov Kopáč near Bratislava. In: Majzlan O (Ed.) Príroda ostrova Kopáč. Fytoterapia OZ pri Pedagogickej fakulte UK, Bratislava, 151–196. [in Slovak with English abstract]
- Majzlan O (2016) Chrobáky (Coleoptera) v Národnej prírodnej rezervácii Burdov. Beetles (Coleoptera) in the Burdov National Nature Reserve. Ochrana Prírody 27: 48–88. [in Slovak with English abstract] http://www.sopsr.sk/publikacie/ved_casopis_OP_27_final.pdf
- Majzlan O (2018) Faunistické príspevky zo Slovenska – Coleoptera 13. Faunistic notes on beetles from Slovakia – Coleoptera 13. Naturae Tutela 22: 245–248. [in Slovak with English abstract] https://www.smopaj.sk/sk/documentloader.php?id=2155&filename=naturae%20tutela_22_2%20na%20internet.pdf
- Majzlan O (2020) Taxocenózy chrobákov (Coleoptera) v lužných lesoch Podunajska pri Bratislave. Taxocoenoses of beetle[s] (Coleoptera) in Danubian floodplain forests near of Bratislava. Naturae Tutela 24: 47–70. [in Slovak with English abstract] https://www.smopaj.sk/sk/documentloader.php?id=2705&filename=nt24_1.pdf
- Majzlan O, Rychlík I, Korbel L (2005) Chrobáky (Coleoptera). In: Majzlan O (Ed.) Fauna Devínskej Kobyly. [Fauna of Devínska Kobyla]. Asociácia priemyslu a ochrany prírody, Bratislava, 89–114. [in Slovak]
- Malesevic E (1892) Losoncz faunája, vagyis az 1876. év őszétől, az 1891. év végeig talált és meghatározott állatfajok rendszeres felsorolása és a fauna jellemzése. [Fauna of Lučenec,

- a systematic review of the species found and identified from the autumn of 1876 to the end of 1891, and the characterization of the fauna]. A Losonci Magyar Királyi Állami Főgymnasium Értesítője 1891–1892: 3–47. [in Hungarian] https://adt.arcanum.com/en/view/Losonc_18594_AllamiFoGimnazium_18615_1891/?pg=4&layout=s
- Manee AH (1908) Some Observations at Southern Pines, N. Carolina. Entomological News and Proceedings of the Entomological Section of the Academy of Natural Sciences of Philadelphia 19: 459–462 + pls xx–xxi. <https://www.biodiversitylibrary.org/item/20252#page/525/mode/1up>
- Mann DJ (2012) Family Geotrupidae Latreille, 1802. In: Duff AG (Ed.) Checklist of Beetles of the British Isles. 2nd Edn. Pemberley Books, Iver, 55–55. <https://www.coleoptera.org.uk/sites/www.coleoptera.org.uk/files/imce/coleoptera/checklist2012.pdf>
- Manolache CI (1930) Colecția Coleopterelor din laboratorul de Zoologie Descriptivă din București donată de W. Knechtel senior. [Collection of Beetles of the laboratory of Descriptive Zoology in Bucharest donated by W. Knechtel senior]. Buletinul Societății Studenților în Științe Naturale din București: 1: 18–20. [in Romanian]
- Markovich A (1909) Prinosa za nasekomnata fauna v Razgradska okolnost. [Contribution to the insect fauna in the Razgrad surroundings]. Sbornik za Narodni Umotvoreniya, Nauka i Knizhnina 25(3): 1–20 [articles paginated separately]. [in Bulgarian] <http://digilib.nalis.bg/xmlui/handle/nls/26358>
- Martín-Piera F, López-Colón JI (2000) Coleoptera – Scarabaeoidea I. Fauna Ibérica. Vol. 14. Museo Nacional de Ciencias Naturales & Consejo Superior de Investigaciones Científicas, Madrid, 526 + [1] pp. + pls 117–123 + [1] p. <http://www.fauna-iberica.mncn.csic.es/english/publicaciones/fi14.php>
- Martynov VV (2003) Novye i interesnye nakhodki plastinchatousykh zhukov (Coleoptera: Scarabaeoidea) na territorii Ukrainy. New and interesting records of Lamellicorn beetles (Coleoptera: Scarabaeoidea) from Ukraine. Izvestiya Kharkovskogo Entomologicheskogo Obshchestva 10[= 2002](1–2): 51–56. [in Russian with English summary] https://www.zin.ru/Animalia/coleoptera/pdf/martynov_2002.pdf
- Martynov VV (2012) Kontrolnyy spisok plastinchatousykh zhukov (Coleoptera: Scarabaeoidea) fauny Ukrainy. A checklist of lamellicorn beetles (Coleoptera: Scarabaeoidea) of the Ukraine. Izvestiya Kharkovskogo Entomologicheskogo Obshchestva 20(2): 11–44. [in Russian with English and Ukrainian abstracts] http://www.irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/Vkhet_2012_20_2_5.pdf
- Marseul SM de (1857) Catalogue des Coléoptères d'Europe. Paris, xvi +200 pp. <https://doi.org/10.5962/bhl.title.66031>
- Medvedev SI (1965) 26. Sem. Scarabaeidae – plastinchatousyye. [26th family: Scarabaeidae – scarab beetles]. In: Bey-Biyenko GYa (Ed.) Opredelitel nasekomykh evropeyskoy chasti SSSR v pyati tomakh. II. Zhestokrylyye i veyerokrylyye. [The key to the identification of insects of the European part of the USSR in five volumes. II. Coleoptera and Strepsiptera]. Nauka, Moskva-Leningrad, 166–208. [in Russian] https://www.zin.ru/animalia/coleoptera/pdf/Part_vol2pp160-208.pdf

- Merkel O (2003) Bogarak. Futrinkák, cincérek, katicabogarak és más bogárcsaládok a Kárpát-medencében. [Insects. Ground beetles, longhorn beetles, ladybird beetles and other beetle families in the Carpathian Basin]. Kossuth Kiadó, Budapest, 112 pp. [in Hungarian]
- Merkel O (2014) Szarvas álganéjtűró *Bolbelasmus unicornis* (Schrank, 1789). [Earth-borer beetle *Bolbelasmus unicornis* (Schrank, 1789)]. In: Haraszthy L (Ed.) Natura 2000 fajok és élőhelyek Magyarországon. [Natura 2000 species and habitats in Hungary]. Pro Vértességi Közalapítvány, Csákvár, 243–245. [in Hungarian] <https://termeszetvedelmikezeles.hu/adatlap-allatok?showAll=0&id=833>
- Merkel O (2015) Szarvas álganéjtűró *Bolbelasmus unicornis* (Schrank, 1789). [Earth-borer beetle *Bolbelasmus unicornis* (Schrank, 1789)]. In: Deli T, Danyik T (Eds) A Körös-Maros Nemzeti Park állatvilága. Gerinctelenek. A Körös-Maros Nemzeti Park természeti értékei II. [Fauna of the Körös-Maros National Park. Invertebrates. Natural values of the Körös-Maros National Park II]. Körös-Maros Nemzeti Park Igazgatóság, Szarvas, 388–389. [in Hungarian]
- Merkel O, Szénási V (2018) A Turjánvidék Natura 2000 terület déli részének bogárfaunája (Coleoptera). The beetle (Coleoptera) fauna of the southern part of the Turjánvidék Natura 2000 site. Rosalia 10: 509–638. [in Hungarian with English abstract] http://turjanvidek.hu/media/statikus/Rosalia_10_pp_509-638.pdf
- Merkel O, Vig K (2009) Bogarak a Pannon régióban. [Beetles in the Pannonian region]. B. K. L. Kiadó, Szombathely, 494 pp. [in Hungarian]
- Merkel O, Ködöböcz V, Deli T, Danyik T (2014) Bogárfaunisztikai adatok a Dél-Tisántúlról (Coleoptera). Faunistic data to the beetles from the south-eastern Great Hungarian Plain (Coleoptera). Crisicum 8: 99–152. [in Hungarian with English abstract] http://real.mtak.hu/126102/1/99_152_Merkel_Crisicum_8_2014.pdf
- Miessen G (2011) Quelques commentaires sur le genre *Bolbelasmus* Boucomont, 1911 et description d'une nouvelle espèce de Chypre. Lambillionea 111: 109–119.
- Miessen G, Trichas A (2011) Description d'un nouveau *Bolbelasmus* Boucomont, 1911 du sud de l'Archipel Egéen (Coleoptera, Scarabaeoidea, Bolboceratidae). Lambillionea 111: 182–188.
- Mikšić R (1953) Fauna Insectorum Balcanica. Scarabaeidae. 15. Beitrag zur Kenntnis der Scarabaeiden. 15. Prilog poznavanju Scarabaeidae. Godišnjak Biološkog Instituta u Sarajevu 6: 49–281. [in German and Bosnian]
- Mikšić R (1958) Scarabaeidae Jugoslavije. Prvi dio. [Scarabaeidae of Yugoslavia. First part]. Naučno društvo Bosne i Hercegovine, Odjeljenje privredno-tehničkih nauka, 150 pp. [in Bosnian]
- Mikšić R (1959) Dritter Nachtrag zur „Fauna Insectorum Balcanica – Scarabaeidae“ (30. Beitrag zur Kenntnis der Scarabaeiden). Godišnjak Biološkog Instituta Univerziteta u Sarajevu 12: 47–136.
- Mikšić R (1960) Die Scarabäiden Jugoslawiens. Systematische Monographie. I. Teil. Biološki Glasnik 13: 313–343.
- Mikšić R (1970) Katalog der Lamellicornia Jugoslawiens (Insecta – Coleoptera). Institut za Šumarstvo, Sarajevo, 71 pp.

- Miller E, Zubowsky N (1917) Materialy po entomologicheskoy faune Bessarabii. [Materials on the insect fauna of Bessarabia]. Trudy Bessarabskago Obshchestva Yestestvoispytateley i Lyubiteley Yestestvoznaniya 6(1914–1915): 119–150. [in Russian]
- Miquel ME, Vasko BN [= BM] (2014) A study of the association of *Odonteus armiger* (Scopoli, 1772) (Coleoptera: Geotrupidae) with the European rabbit. Journal of Entomology and Zoology Studies 1(6): 157–167. https://www.entomoljournal.com/vol1Issue6/Issue_Dec_2013/31.2.pdf
- Mitter H (2000) Die Käferfauna Oberösterreichs (Coleoptera: Heteromera und Lamellicornia). Beiträge zur Naturkunde Oberösterreichs 8: 3–192. https://www.zobodat.at/pdf/BNO_0008_0003-0192.pdf
- Mollandin de Boissy R (1906) Communications. Sur *Bolboceras gallicum* Muls. (Col.). Bulletin de la Société Entomologique de France 1906(13): 178. <https://doi.org/10.3406/bsef.1906.23946>
- Montandon AL (1906) Notes sur la faune entomologique de la Roumanie. Buletinul Societății de Științe din București – România 15: 30–80. <https://www.biodiversitylibrary.org/item/39574#page/36/mode/1up>
- Montreuil O (2014) Bolboceratidae. In: Tronquet M (Ed.) Catalogue des Coléoptères de France. Association Roussillonnaise d'Entomologie, Perpignan, 376–376.
- Mulsant E, Rey C (1871) Histoire naturelle des Coléoptères de France. Lamellicornes – Pectinicornes. A. Deyrolle, Paris, [4] + 735 + [1] + 42 + [3] pp. , 3 pls. <https://doi.org/10.5962/bhl.title.8758>
- Murraj Xh (1962) Kontribut për faunën e krahëfortëve (Coleoptera) të vendit tonë. Contribution à la faune des Coléoptères en Albanie. Buletin i Universitetit Shtetëror të Tiranës, Seria Shkencat Natyrore 16: 118–128. [in Albanian with French summary]
- Nádai L (2006) A Bolboceratinae alcsalád magyarországi fajainak lelőhelyadatai (Coleoptera, Scarabaeoidea: Geotrupidae). Hungarian localities of the species of Bolboceratinae (Coleoptera, Scarabaeoidea: Geotrupidae). Folia Historico-Naturalia Musei Matraensis 30: 205–210. [in Hungarian with English abstract] https://matramuzeum.nhmus.hu/sites/default/files/nhmusfiles/kiadvanyok/fofia/vol30/205_210Matra.pdf
- Neculiseanu Z, Dănilă A, Cilipic G (2002) Lista insectelor rare și amenințate cu dispariția din Republica Moldova. *Bolbelasmus unicornis* Schrank, 1798. [List of rare and endangered insects in the Republic of Moldova: *Bolbelasmus unicornis* Schrank, 1798]. SalvaEco, Chișinău. [in Romanian] https://www.salvaeco.org/insecte/page/bolbelasmus_unicornis.php [accessed 4 December 2021]
- Nedyalkov N (1906) Prinós kam entomologichnata fauna na Bulgaria. [A contribution to the Bulgarian insect fauna]. Periodichesko Spisanie na Bulgarskoto Knizhno Druzhestvo v Sofia 17[=1905]: 404–439. [in Bulgarian] <http://digilib.nalis.bg/xmlui/handle/nls/28595>
- Nedyalkov N (1909) Peti prinós kam entomologichnata fauna na Bulgaria. [Fifth contribution to the Bulgarian insect fauna]. Sbornik za Narodni Umotvoreniya, Nauka i Knizhnina 25(3): 1–37 [articles paginated separately]. [in Bulgarian] <http://digilib.nalis.bg/xmlui/handle/nls/26358>

- Németh T (2013) Trip reports, VI.2013, Isaszeg. Hungarian Natural History Museum, Department of Zoology, Budapest. http://coleocoll.nhmus.hu/kepek/TRIPREPORTS/Reports/2013.VI.Isaszeg_english.html [accessed 15 December 2020]
- Németh T (2015) Szarvas álganéjtúró. [Earth-borer beetle *Bolbelasmus unicornis*]. Élet és Tudomány 70: 1119. [in Hungarian] http://epa.oszk.hu/02900/02930/00135/pdf/EPA02930_elet_es_tudomany_2015_35.pdf
- Nikolajev GV, Král D, Bezděk A (2016) family Geotrupidae Latreille, 1802. In: Löbl I, Löbl D (Eds) Catalogue of Palearctic Coleoptera. Volume 3: Scarabaeoidea – Scirtoidea – Dascilloidea – Buprestoidea – Byrrhoidea. Revised and Updated Edition. Brill, Leiden – Boston, 33–52. https://doi.org/10.1163/9789004309142_003
- Nițu E (2001) Edaphic and subterranean Coleoptera from the Dobrogean karstic areas (Romania). A zoogeographic approach. Mitteilungen aus den Hamburgischen Zoologischen Museum und Institut 98: 131–169.
- Nițu E (2007) Studii eco-faunistice asupra asociațiilor de coleoptere edafice din zona Sic-Păstăraia (Câmpia Transilvaniei). Eco-faunistic studies on the soil Coleoptera in the Sic-Păstăraia area (Transylvanian Plane). Analele Institutului de Cercetări și Amenajări Silvice 50: 153–167. [in Romanian with English abstract] <http://www.editurasilvica.ro/analeleicas/50/1/nitu.pdf>
- Novák I (1989) Seznam lokalit a jejich kódů pro síťové mapování entomofauny Československa. [List of localities and their codes for grid mapping of entomofauna of Czechoslovakia]. Zprávy Československé Společnosti Entomologické při ČSAV 25: 3–84. [in Czech]
- Nuß M, Jäger O (2020) Vierzähniger Mistkäfer (*Bolbelasmus unicornis* Schrank, 1789). Insekten Sachsen. <https://www.insekten-sachsen.de/pages/TaxonomyBrowser.aspx?id=188691> [accessed 22 April 2022]
- Oechsner G (1854) Die Käfer der Umgegend Aschaffenburgs. Ein Beitrag zu den Lokalfaunen Bayerns. Programm der königlichen Landwirtschafts- und Gewerbs-Schule zu Aschaffenburg zur Feier ihrer öffentlichen Schlussprüfung und Preisvertheilung im Schuljahre 1853 in 1854. Wailandt, Aschaffenburg, iv. + 48 pp. http://digital.bib-bvb.de/view/bvb_single/single.jsp?dvs=1639010751724-0&locale=cs&VIEWER_URL=/view/bvb_single/single.jsp?&DELIVERY_RULE_ID=39&bfe=view/action/singleViewer.do?dvs=&frameId=1&usePid1=true&usePid2=true
- Oertzen E von (1886) Verzeichniss der Coleopteren Griechenlands und Cretas, nebst einigen Bemerkungen über ihre geographische Verbreitung und 4 die Zeit des Vorkommens einiger Arten betreffenden Sammelberichten. Berliner Entomologische Zeitschrift 30: 189–293. <https://www.biodiversitylibrary.org/item/100061#page/231/mode/1up>. <https://doi.org/10.1002/mmnd.18870300211>
- Ohaus F (1929) Aus der Praxis des Käfersammlers. XII. Über das Sammeln und Züchten von Mistkäfern. Koleopterologische Rundschau 15: 141–150. https://www.zobodat.at/pdf/KOR_15_1929_0141-0150.pdf
- Ohloblin [= Ogloblin] DO (1913) Materialy k izucheniu Coleoptera Poltavskoy gub. Contribution à la faune des Coleopteres de la gouvernement de Poltawa. Yezhegodnik Yestestvenno-Istoricheskago Muzeya Poltavskago Gubernskago Zemstva 1: 29–36. [in Russian with French title]

- Ortvay T (1902) Pozsony vármegye és a területén fekvő Pozsony, Nagyszombat, Bazin, Modor s Szentgyörgy városok állatvilága. Állatrajzi és állatgazdaságtörténeti monografia. Első kötet: állatrajzi rész. [The fauna of Bratislava County and the cities of Bratislava, Trnava, Pezinok, Modra and Svätý Jur. Zoological and zoohistorical monograph. Volume 1: zoological part]. K. Stampfel, Pozsony [= Bratislava], xvi + 647 + [1] pp. [in Hungarian]
- Paill W (2007) Wiederfund von *Bolbelasmus unicornis* (SCHRANK, 1789) in den Wiener Donauauen (Coleoptera: Scarabaeoidea: Geotrupidae). (Rediscovery of *Bolbelasmus unicornis* in Vienna's Lobau). Beiträge zur Entomofaunistik 8: 165–171. https://www.zobodat.at/pdf/BEF_8_0165-0171.pdf
- Paill W, Mairhuber C (2006) Checkliste und Rote Liste der Blatthornkäfer und Hirschkäfer Kärntens mit besonderer Berücksichtigung der geschützten Arten (Coleoptera: Trogidae, Geotrupidae, Scarabaeidae, Lucanidae). Carinthia II 196/116: 611–626. https://www.zobodat.at/pdf/CAR_196_116_0611-0626.pdf
- Paill W, Mairhuber C (2012) Käfer der FFH-Richtlinie in Niederösterreich. Basisdatenerhebung FFH-Käfer Niederösterreich (RU5-S, 845/001-2009). ÖKOTEAM – Institut für Tierökologie & Naturraumplanung OG, Graz, 48 pp. https://www.noe.gv.at/noe/Naturschutz/BDE_Kaefer_2012.pdf
- Panin S (1957) Coleoptera: familia Scarabaeidae (subfamiliile: I Coprinae, II Geotrupinae, III Aphodiinae, IV Aegialinae, V Hybosorinae, VI Ochodaeinae, VII Orphninae, VIII Troginae, IX Glaphyrinae, X Sericinae, XIII Hoplinae, XIV Dynastinae, XV Valginae, XVI Trichiinae și XVII Cetoniinae). Fauna Republicii Populare Romîne. Insecta. Volumul X. Fascicola 4. Editura Academiei R.P.R., București, 316 pp. + 36 pls. [in Romanian]
- Panzer GWF (1793a) Beyträge zur Geschichte der Insekten. Symbolae Entomologicae. I. Theil. Johan Jakob Palm, Erlangen, 24 pp. + 6 pls.
- Panzer GWF (1793b) Faunae insectorum Germanicae initia. Deutschlands Insecten. Heft 12. Felsecker, Nürnberg, 24 pp. + 24 pls. <https://doi.org/10.5962/bhl.title.15007>
- Panzer GWF (1795) Deutschlands Insectenfaune oder entomologisches Taschenbuch für das Jahr 1795. Entomologia Germanica exhibens insecta per Germaniam indigena secundum classes, ordines, genera, species adiectis synonymis, locis, observationibus. I. Eleuterata. Cum tabulis aeneis. Felsecker, Nürnberg, [32] + 370 + [2] pp. + 12 pls. <https://doi.org/10.5962/bhl.title.11756>
- Panzer GWF (1802) Beyträge zur Geschichte der Insekten. Johann Euseb Voets Beschreibungen und Abbildungen hartschaalichter Insecten. Coleoptera Linn. Aus dem Original getreu übersetzt mit der in selbigem fehlenden Synonymie und beständigen Commentar versehen von D. Georg Wolfgang Franz Panzer. Fünfter Theil. Mit zwölf Kupfertafeln. Symbolae Entomologicae. Johann Jacob Palm, Erlangen, [2] + 114 pp. + 12 pls. <https://doi.org/10.5962/bhl.title.65761>
- Paulian R (1941) Coléoptères Scarabéides. Faune de France 38. Paul Lechevalier et Fils, Paris, 240 pp. [https://faunedefrance.org/bibliotheque/docs/R.PAULIAN\(FdeFr38\)Scarabeides1.pdf](https://faunedefrance.org/bibliotheque/docs/R.PAULIAN(FdeFr38)Scarabeides1.pdf)
- Paulian R (1959) Coléoptères Scarabéides. (Deuxième édition, revue et augmentée). Faune de France 63. Éditions Paul Lechevalier, Paris, 298 pp. <https://faunedefrance.org/faune-63>
- Paulian R, Baraud J (1982) Faune des Coléoptères de France II. Lucanoidea et Scarabaeoidea. Encyclopédie Entomologique 43. Éditions Lechevalier S.A.R.L., Paris, 477 pp.

- Peez A von, Kahlen M (1977) Die Käfer von Südtirol. Faunistisches Verzeichnis der aus der Provinz Bozen bisher bekannt gewordenen Koleopteren. Selbstverlag des Tiroler Landesmuseum Ferdinandeum, Innsbruck, 525 pp. https://www.zobodat.at/pdf/VeroeffFerd_57_BL_0001-0525.pdf
- Pescarolo R (1990) Ricerche sui coleotteri della Valle del Ticino. La Rivista Piemontese di Storia Naturale 11: 81–104. http://www.storianaturale.org/anp/PDF%20ANP/11_1990_Pescarolo_Ricerche%20sui%20Coleotteri%20della%20Valle%20del%20Ticino_81-104.pdf
- Peslier S (2004) Clé de détermination illustrée des Geotrupidae de France (Coleoptera, Scarabaeoidea). Revue de l'Association Roussillonnaise d'Entomologie 13: 1–9. <https://r-a-r-e.fr/wp-content/uploads/2019/10/2004-XIII-1.pdf>
- Petersen B, Vischer-Leopold M, Wurst C (2006) *Bolbelasmus unicornis* (Schrank, 1789). In: Petersen B, Ellwanger G (Eds) Das Europäische Schutzgebietssystem Natura 2000. Ökologie und Verbreitung von Arten der FFH-Richtlinie in Deutschland, Band 3: Arten der EU-Osterweiterung. Bundesamt für Naturschutz, Bonn-Bad Godesberg, 85–89.
- Petri K (1912) Siebenbürgens Käferfauna auf Grund ihrer Erforschung bis zum Jahre 1911. Siebenbürgischen Verein für Naturwissenschaften zu Hermannstadt, Hermannstadt, ix + [1] + 376 pp. <https://doi.org/10.5962/bhl.title.8978>
- Petrovitz R (1956) Die koprophagen Scarabaeiden des nördlichen Burgenlandes. Wissenschaftliche Arbeiten aus dem Burgenland, Heft 13. Burgenländisches Landesmuseum, Eisenstadt, 24 pp. https://www.zobodat.at/pdf/Wiss-Arbeiten-Burgenland_013_0001-0024.pdf
- Petrovitz R (1959) Beitrag zur Scarabeiden – Fauna der Insel Rhodos. Bollettino del Laboratorio di Entomologia Agraria 17: 124–130.
- Pétsch N, Szénási V (2019) (Eds) A HUDI20023 Gödöllői-dombság kiemelt jelentőségű természetmegőrzési terület Natura 2000 fenntartási terve. [Conservation plan for the Natura 2000 priority protected area HUDI20023 Gödöllő Hills]. Duna-Ipoly Nemzeti Park Igazgatóság, Budapest, 126 pp. [in Hungarian] http://dinp.nemzetipark.gov.hu/_user/browser/File/Natura2000/Godolloi_dombsag_Natura2000_fenntartasi_terv_egyeztetesi_anyag.pdf
- Pirnat A (2009) Govnač vrste *Bolbelasmus unicornis*. [Earth-borer beetle *Bolbelasmus unicornis*]. In: Vrezec A (Ed.) Izvajanje spremljanja stanja populacij izbranih ciljnih vrst hroščev v letu 2008 in 2009 in zasnova spremljanja stanja populacij izbranih ciljnih vrst hroščev. [Implementation of population monitoring of selected target beetle species in 2008 and 2009, and design of population monitoring of selected target beetle species]. Nacionalni inštitut za biologijo, Ljubljana, and Notranjski muzej Postojna, 113–125. [in Slovenian] http://www.natura2000.si/fileadmin/user_upload/knjiznica/raziskave/Hroschi_monitoring_koncono_porocilo_09.pdf
- Pittioni E (1943) Die Käfer von Niederdonau: Die Curti-Sammlung im Museum des Reichsgaues Niederdonau, II. Silphidae – Pythidae. Niederdonau – Natur und Kultur 23: 67–130.
- Polentz G (1927) Coleopterologische Streifzüge um Trentschin (Slowakei). Zeitschrift für Entomologie 15: 9–15.
- Porta A (1932) Fauna Coleopterorum Italica. Vol V. – Rhynchophora-Lamellicornia. Anthribidae, Brenthidae, Curculionidae, Nemonychidae, Ipidae, Lucanidae, Scarabaeidae. Stabilimento Tipografico Piacentino, Piacenza, 476 pp.

- Portevin G (1931) Histoire naturelle des Coléoptères de France. Tome II. Polyphaga: Lamellicornia, Palpicornia, Diversicornia. Encyclopédie Entomologique, Série A, XIII. Paul Lechevalier & Fils, Paris, vi. + [2] + 542 + [1] pp. + pls vi–x. <https://documentcloud.adobe.com/link/review?uri=urn:aaid:scds:US:9cd3ab47-d65e-4f06-91cc-7e075579a1c4>
- Potocký P, Majzlan O (2015) Metodika monitoringu hubára jednorohého *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera, Geotrupidae). [Monitoring methods for the earth-borer beetle *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera, Geotrupidae)]. Štátna ochrana prírody SR Banská Bystrica, 15 pp. [in Slovak] <https://www.biomonitoring.sk/Monitoring/MonitoringMethodology/DownloadFile/33> [accessed 12 September 2021]
- Prossen T (1913) I. Nachtrag zum Verzeichnisse der bisher in Kärnten beobachteten Käfer (3. Fortsetzung und Schluß). Carinthia II 103/23: 74–85. https://www.zobodat.at/pdf/CAR_103_23_0074-0085.pdf
- Pruner L, Míka P (1996) Seznam obcí a jejich částí v České republice s čísly mapových polí pro síťové mapování fauny. List of settlements in the Czech Republic with associated map fields codes for faunistic map system. Klapalekiana 32(Supplementum): 1–115. [in Czech with English abstract]
- Rabl D, Rabl S, Rabl Ch (2019) Ein neuer Nachweis von *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera: Geotrupidae) aus dem Naturschutzgebiet Sandberge Oberweiden, Niederösterreich. A new record of *Bolbelasmus unicornis* (Schrank, 1789) (Coleoptera: Geotrupidae) from the nature reserve Sandberge Oberweiden, Lower Austria. Beiträge zur Entomofaunistik 20: 252–254. https://www.zobodat.at/pdf/BEF_20_0252-0254.pdf
- Rahola Fabra P (2004) Biologie de *Bolbelasmus gallicus* (Mulsant, 1842) (Coleoptera: Geotrupidae: Bolboceratinae) dans le Department du Gard (Languedoc, sud de la France). Elytron 17: 37–46.
- Redtenbacher L (1849) Fauna Austriaca. Die Käfer. Nach der analytischen Methode. Carl Gerold, Wien, xxvii + 883 pp. + 2 pls. <https://doi.org/10.5962/bhl.title.37851>
- Redtenbacher L (1858) Fauna Austriaca. Die Käfer. Nach der analytischen Methode. Zweite, gänzlich umgearbeitete, mit mehreren Hunderten von Arten und mit der Charakteristik sämtlicher europäischen Käfergattungen vermehrte Auflage. Mit zwei Kupfertafeln. Carl Gerold's Sohn, Wien, cxxxvi + 1017 pp. + 2 pls. <https://doi.org/10.5962/bhl.title.9570>
- Redtenbacher L (1874) Fauna Austriaca. Die Käfer, nach der analytischen Methode. Dritte, gänzlich umgearbeitete und bedeutend vermehrte Auflage. Erster Band. Mit zwei Kupfertafeln. Carl Gerold's Sohn, Wien, 564 pp. <https://doi.org/10.5962/bhl.title.9061>
- Reitter E (1892) Bestimmungs-Tabelle der Lucaniden und coprophagen Lamellicornen. XXIV. Heft. Edmund Reitter, Brno, 230 pp. https://www.zobodat.at/pdf/MON-E-COL_0020_0001-0230.pdf
- Reitter E (1909) Fauna Germanica. Die Käfer des Deutschen Reiches. II. Band. Nach der analytischen Methode bearbeitet. Mit 70 Text-Illustrationen und 40 Farbendrucktafeln, zusammengestellt und redigiert von Dr. K. G. Lutz. K. G. Lutz' Verlag; Stuttgart, 392 pp. + pls 41–80. https://www.zin.ru/animalia/coleoptera/pdf/reitter_band_ii_text.pdf
- Ressler F, Kust T (2010) Naturkunde des Bezirkes Scheibbs. Tierwelt 4. Wissenschaftliche Mitteilungen aus dem Niederösterreichischen Landesmuseum 20: 11–436. https://www.zobodat.at/pdf/WM_20_0011-0436.pdf

- Ritcher PO (1947) Larvae of Geotrupinae with keys to tribes and genera (Coleoptera: Scarabaeidae). Bulletin of the Kentucky Agricultural Experiment Station 506: 1–27. <https://dspace.gipe.ac.in/xmlui/bitstream/handle/10973/36161/GIPE-037617.pdf?sequence=3&isAllowed=y>
- Ritcher PO (1966) White grubs and their allies. A study of North American scarabaeoid larvae. Studies in entomology number four. Oregon State University Press, Corvallis, 219 pp. <https://ir.library.oregonstate.edu/downloads/nk322k13b>
- Ritcher PO, Baker ChW (1974) Ovarioles numbers in Scarabaeoidea (Coleoptera: Lucanidae, Passalidae, Scarabaeidae). Proceedings of the Entomological Society of Washington 76: 480–494. <https://www.biodiversitylibrary.org/item/55199#page/510/mode/1up>
- Rößler G (1989) Bemerkenswerte Käferfunde aus dem nördlichen Burgenland (Carab., Halpl., Dytisc., Hydraen., Hydroph., Staph., Coccin., Scarab., Ceramb., Curcul.). Entomologische Blätter 85: 126–127.
- Roubal J (1936) Katalog Coleopter (brouků) Slovenska a Podkarpatské Rusi na základě bionomického a zoogeografického a spolu systematického doplněk Ganglbauerových „Die Käfer von Mitteleuropa“ a Reitterovy „Fauna Germanica“. Díl II. Catalogue des Coléoptères de la Slovaquie et de la Russie Subcarpathique d'après les documents et zoogéographiques ainsi que supplément systématique au Ganglbauer „Die Käfer von Mitteleuropa“ et Reitter „Fauna Germanica“. Tome II. Učená Společnost Šafaříkova, Bratislava, viii + 434 pp. [in Czech with French introduction]
- Roubal J (1938) Thermophile Coleopteren der Slovakei (mit besonderer Berücksichtigung der xerothermicolen Arten) und ihr Eindringen nordwärts der Donau nebst Ergänzung des Lebensbildes der betreffenden Biotope durch andere, nicht exclusiv thermophile Arten. Festschrift zum 60. Geburtstag von Professor Dr. Embrik Strand 4: 405–437.
- Rozner I (1984) A Bakony hegység lemezescsápú bogárfaunájának alapvetése I. (Coleoptera: Trogidae & Scarabaeidae). [Fauna of Trogidae and Scarabaeidae (Coleoptera) of the Bakony Mountains I]. Folia Musei Historico-Naturalis Bakonyiensis 3: 71–124. [in Hungarian] https://library.hungaricana.hu/hu/view/SZAK_BAKO_Btmk_03_1984/?pg=72&layout=s
- Rozner Gy (2001) Somogy megye dögbogár, sutabogár és lemezescsápú bogár faunája (Coleoptera: Silphidae, Histeridae, Lamellicornia). [Fauna of carrion beetles, clown beetles and lamellicorn beetles (Coleoptera: Silphidae, Histeridae, Lamellicornia) in the Somogy county]. Natura Somogyiensis 1: 161–167. [in Hungarian with English abstract] <https://doi.org/10.24394/NatSom.2001.1.161>
- Rózsay E (1868) Catalogus coleopterorum Posonii et Cassoviae inventorum. A Pozsonyi Királyi Katolikus Főgymnasium Értésítvénye 1867–1868: 13–20. [in Hungarian with Latin title] https://adt.arcanum.com/en/view/Pozsony_28386_KathFogymnasium_28401_1867/?pg=12&layout=s
- Rózsay E (1880) Enumeratio Coleopterorum Posoniensium. Adalék Pozsony rovarfaunájának ismeretéhez. [An addition to the knowledge of the insect fauna of Bratislava]. Pozsonyi Természettudományi és Orvosi Egylet Közleményei 1873–1875: 25–54. [in Hungarian with Latin title] <https://www.biodiversitylibrary.org/item/192931#page/33/mode/1up>
- Ruicănescu A, Nițu E (2008) 4011 *Bolbelasmus unicornis*. In: Goriup P (Ed.): Natura 2000 in Romania. Species fact sheets. Ministry of Environment and Sustainable Development,

- Bucharest, 302–303. [in English and Romanian] <https://www.crayfish.ro/anexe/Species-FactSheetsFeb08.pdf>
- Rybiński M (1897) Wykaz chrząszczów nowych dla fauny galicyjskiej. [List of beetles new to the Galician fauna]. Sprawozdanie Komisji Fizyograficznej 32(2): 46–62. [in Polish] <https://www.biodiversitylibrary.org/item/129225#page/301/mode/1up>
- Rybiński M (1903) Wykaz chrząszczów zebranych na Podolu galicyjskiem przy szlaku kolejowym Złoczów-Podwołoczyska w latach 1884–1890. [List of beetles collected in Galician Podolia alongside the Zolochivka-Pidvolochysk railway line in 1884–1890]. Sprawozdanie Komisji Fizyograficznej 37(2): 57–175. [in Polish] <https://www.biodiversitylibrary.org/item/129184#page/301/mode/1up>
- Sainte-Claire Deville J (1936) Catalogue raisonné des Coléoptères de France. L'Abeille 36(2): 161–264.
- Sajó K (1881) Daten zur Insekten-Statistik von Kis-Szent-Miklós (Pester Komitat, Bezirk: Waitzen). Zeitschrift für Entomologie Breslau 8: 40–65. <https://www.biodiversitylibrary.org/item/213874#page/62/mode/1up>
- Sajó K (1897) Beitrag zu den Lautäusserungen der Käfer. Illustrierte Wochenschrift für Entomologie 2: 544. <https://www.biodiversitylibrary.org/item/98743#page/564/mode/1up>
- Sajó K (1910a) A szarvasgombák. [The truffles]. Uránia 11: 204–212. [in Hungarian] http://real-j.mtak.hu/10710/1/MTA_Urania_1910.pdf
- Sajó K (1910b) Aus der Käferwelt. Mit Rücksicht auf die Beziehungen der Kerfe zur menschlichen Kulturgeschichte. Theodor Thomas, Leipzig, 89 pp.
- Sár J, Horvatovich S (2000) Lemezescsapú bogarak (Coleoptera: Lamellicornia) a Villányi-hegységből. Lamellicornia (Coleoptera) from the Villány Hills, South Hungary. Dunántúli Dolgozatok Természettudományi Sorozat 10: 215–222. [in Hungarian with English abstract] https://library.hungaricana.hu/hu/view/MEGY_SOMO_Osborokas_10/?pg=216&layout=s
- Savchenko YeM (1931) Beitrag zur Kenntnis der Scarabaeidenfauna Wolyniens. Trudy Pryrodnycho-Tekhnichnoho Viddilu 5: 43–62.
- Savchenko YeM (1933) Ohlyad zhukiv-lystorozhtsiv (Coleoptera, Scarabaeidae) Podillya. Uebersicht der Podolischen Blatthornkäfer (Coleoptera, Scarabaeidae). Zbirnyk Prac Zoologichnoho Muzeiu 12: 121–143. [in Ukrainian with German summary]
- Savchenko YeM (1934) Fauna zhukiv-lystorozhtsiv (Coleoptera, Scarabaeidae) Kyivshchyny ta yii zooheohrafichnyi kharakter. Fauna der Blatthornkäfer (Scarabaeidae) des Kyjiwer Gebiets und deren zoogeographischer Charakter. Zbirnyk Prac Zoologichnoho Muzeiu 13: 41–85. [in Ukrainian with German and Russian summaries]
- Savchenko YeM (1938) Materialy do fauny URSS – plastynchastovusi zhuky (Coleoptera, Scarabaeidae). Beitrag zur Blatthornkäferfauna (Coleoptera, Scarabaeidae) Ukr. SSR. Vydavnytstvo Akademii Nauk URSS, Kyiv, 208 pp. [in Ukrainian with Russian and German summaries]
- Schatzmayer A (1936) Risultati scientifici delle cacce entomologiche di S.A.S. il principe Alessandro Della Torre e Tasso nelle isole dell'Egeo. VI. Scarabaeidae. Bollettino Laboratorio Zoologia Generale Agraria Reale Istituto Superiore Agrario Portici 30: 9–23.

- Schaufuss C (1916) Calwer's Käferbuch. Einführung in die Kenntniss der Käfer Europas. Band II. E. Schweizerbart'sche Verlagsbuchhandlung Nägele & Dr. Sproesser, Stuttgart, 7pp. 710–1390 + pls 21–48. <https://doi.org/10.5962/bhl.title.39556>
- Scherdlin P (1915) Supplément au Catalogue des Coléoptères de la chaîne des Vosges et des régions limitrophes. Bulletin de la Société d'Histoire Naturelle de Colmar, Nouvelle Série 13: 293–590. <https://doi.org/10.5962/bhl.title.8778>
- Scherdlin P (1920) Deuxième supplément au Catalogue des Coléoptères de la chaîne des Vosges et des régions limitrophes. Bulletin de la Société d'Histoire Naturelle de Colmar, Nouvelle Série 15: 1–255. <https://doi.org/10.5962/bhl.title.8778>
- Schlögl L (1883) Die Coleopteren-Fauna aus dem Marchthale bei Ung. Hradisch (Schluß.). Programm des K. K. Real- und Ober-Gymnasiums in Ungarisch Hradisch in Mähren 1882/1883: 3–30.
- Schlosser Klekovski JK (1878) Fauna kornjašah Trojedne Kraljevine. Svezak drugi. [The beetle fauna of the Triune Kingdom. Volume two]. Jugoslavenska akademija znanosti i umjetnosti, Zagreb, 343–726. [in Croatian] <http://library.foi.hr/knjige/knjiga1.aspx?B=1&C=X00383&fl=t>
- Schmölzer K (1989) Beitrag zur Kenntniss der Käferfauna des Eichkogels (NÖ). Sitzungsberichte der Akademie der Wissenschaften Mathematisch-Naturwissenschaftliche Klasse 197: 223–286. https://www.zobodat.at/pdf/SBAWW_197_0223-0286.pdf
- Schönherr CJ (1806) Synonymia Insectorum, oder: Versuch einer Synonymie aller bisher bekannten Insecten; nach Fabricii Systema Eleutheratorum geordnet, mit Berichtigungen und Anmerkungen, wie auch Beschreibungen neuer Arten und illuminirten Kupfern. Erster Band. Eleutherata oder Käfer. Erster Theil. Lethrus – Scolytes. Heinr. A. Nordström, Stockholm, xxii + 293 pp. + [1] + 3 pls. <https://doi.org/10.5962/bhl.title.66107>
- Schoolmeesters P (2019) Scarabs: World Scarabaeidae Database (version Jan 2019). In: Roskov Y, Ower G, Orrell T, Nicolson D, Bailly N, Kirk PM, Bourgoin T, DeWalt RE, Decock W, Nieukerken E van, Zarucchi J, Penev L (Eds) Species 2000 & ITIS Catalogue of Life, 2019 Annual Checklist. Naturalis, Leiden. <https://www.catalogueoflife.org/annual-checklist/2019> [accessed 19 October 2021]
- Schrank von Paula F (1789) Entomologische Beobachtungen. Der Naturforscher 24: 60–90. http://ds.ub.uni-bielefeld.de/viewer/image/2108412_024/65
- Schubert F (1905) Die Coleopteren-Fauna von Prosnitz und Umgebung. Jahres-Bericht der Deutschen Landes-Oberrealschule zu Prosnitz 30: 3–27.
- Schwarz M (2008) Pilotprojekt: Grundlagen für den Schutz ausgewählter Insektengruppen in Oberösterreich. Abteilung Naturschutz des Landes Oberösterreich, Linz, 159 pp. https://www.zobodat.at/pdf/GUTNAT_0669_0001-0159.pdf
- Schweiger H (1951) Käferfang bei Nacht. Entomologisches Nachrichtenblatt Österreichischer und Schweizer Entomologen 3: 193–198. https://www.zobodat.at/pdf/ZAOE_3_0193-0198.pdf
- Seidlitz GCM von (1891) Fauna Transsylvanica. Die Kaefer (Coleoptera) Siebenbürgens. Mit 1 Tafel. Hartung, Königsberg, lvi + 192 + 914 pp. + 1 pl. <https://doi.org/10.5962/bhl.title.123006>

- Sevastianov VD (2000) Poperednii opys kolektsii zhukiv I. B. Bertoldi. Preliminary description of I. B. Bertoldi's beetles collection. *Visnyk Odeskoho Natsionalnoho Universytetu* 5: 295–298. [in Ukrainian with Russian and English summaries] <http://dspace.onu.edu.ua:8080/bitstream/123456789/16882/1/295-298.pdf>
- Sevastianov VD (2001) Poperednii opys kolektsii zhukiv I. B. Bertoldi (povidomlennia druhe). The preliminary description of I. B. Bertoldi's beetles collection (the second report). *Visnyk Odeskoho Natsionalnoho Universytetu* 6: 222–226. [in Ukrainian with Russian and English summaries] <http://dspace.onu.edu.ua:8080/bitstream/123456789/16516/1/222-226.pdf>
- Sherborn CD (1902) *Index animalium sive index nominum quae ab A.D. MDCCLVIII generibus et speciebus animalium imposita sunt societatibus eruditorum adiuvantibus. Sectio prima. A kalendis Ianuariis, MDCCLVIII usque ad finem Decembris, MDCCC.* Cambridge, lix + 1071 pp. <https://doi.org/10.5962/bhl.title.159249>
- Sheshurak PN, Voblenko AS, Kavurka VV, Berest ZL, Nazarov NV (2018) Bespozvonochnyye, vnesonnyye v krasnuyu knigu Ukrainy, vstrechayushchiesya na territorii Chernigovskoy oblasti. [Invertebrates included in the Red Book of Ukraine found on the territory of Chernihiv Oblast]. In: Akimov IA, Kharchenko VO, Kostushyn VA, Vasyliuk OV (Eds) *Materialy do 4-ho vydannia Chervonoj knyhy Ukrainy. Tvarynnyi svit. Tom 2.* [Materials for the 4th edn. of the Red Book of Ukraine. Fauna. Volume 2]. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, 367–381. [in Russian] http://mail.izan.kiev.ua/RedBook18_T2_web.pdf#page=368
- Sheshurak PN, Voblenko AS, Kavurka VV, Nazarov NV (2020a) Nakhodki nasekomykh, vnesënniykh v prilozheniya Konventsii ob okhrane dikoy fauny i flory i prirodnikh sred obitaniya v Yevrope (Bernskoy konventsii), na territorii Ukrainy. [Faunistic records of insect species included in the Annexes of the Berne Convention on the Conservation of European Wildlife and Natural Habitats in the territory of Ukraine]. In: Kuzemko AA, Sadohurska SS, Holdin PYe, Kavurka VV, Kutsokon YuK, Nekrasova OD, Vasyliuk OV, Prylutskyi OV, Rusin MYu (Eds) *Znakhidky vydiv roslyn, tvaryn ta hrybiv, shcho znakhodiatsia pid okhoronoju, v Ukraini. Serii: «Conservation Biology in Ukraine». Vypusk 19.* Records of protected animal, plant and fungi species in Ukraine. Series: «Conservation Biology in Ukraine», Issue 19. TVORY, Vinnytsia, 613–626. [in Russian] https://uncg.org.ua/wp-content/uploads/2021/01/New_FC-Ed_REDbook_2020_BOOK_print-1.pdf
- Sheshurak PN, Voblenko AS, Kavurka VV, Nazarov NV (2020b) Bespozvonochnyye, vnesënniyke v prilozheniya Konventsii ob okhrane dikoy fauny i flory i prirodnikh sred obitaniya v Yevrope (Bernskoy konventsii), vstrechayushchiesya na territorii Chernigovskoy oblasti. [Invertebrates included in the Annexes of the Berne Convention on the Conservation of European Wildlife and Natural Habitats, found in the territory of the Chernihiv Oblast]. In: Kuzemko AA, Sadohurska SS, Holdin PYe, Kavurka VV, Kutsokon YuK, Nekrasova OD, Vasyliuk OV, Prylutskyi OV, Rusin MYu (Eds) *Znakhidky vydiv roslyn, tvaryn ta hrybiv, shcho znakhodiatsia pid okhoronoju, v Ukraini. Serii: «Conservation Biology in Ukraine». Vypusk 19.* Records of protected animal, plant and fungi species in Ukraine. Series: «Conservation Biology in Ukraine», Issue 19. TVORY, Vinnytsia, 583–612. [in Russian] https://uncg.org.ua/wp-content/uploads/2021/01/New_FC-Ed_REDbook_2020_BOOK_print-1.pdf

- Shokhin IV (2007) Materialy k faune plastinchatousykh zhukov (Coleoptera, Scarabaeoidea) Yuzhnoy Rossii. Contribution to the fauna of lamellicorn beetles (Coleoptera, Scarabaeoidea) of Southern Russia, with some nomenclatural changes in the family Scarabaeidae. Kavkazskiy Entomologicheskiiy Byulleten' 3(2): 105–185. [in Russian with English abstract] <https://doi.org/10.23885/1814-3326-2007-3-2-105-185>
- Sim RJ (1930) Scarabæidæ, Coleoptera; Observations on species unrecorded or little-known in New Jersey. Journal of the New York Entomological Society 38: 139–147. <https://www.biodiversitylibrary.org/item/206060#page/173/mode/1up>
- Skrimshire W (1812) Remarks on some rare Insects found during a Flood at Wisbech. The Transactions of the Entomological Society of London 1: 315–322. <https://books.google.cz/books?id=EMwEAAAAQAAJ&pg=PA70&lpg=PA70&dq=skrimshire,+entomological+transaction&source=bl&ots=mxGokrV7Je&sig=ACfU3U33j33N-gwnwbHUHWqwR3yRJlhLgw&hl=cs&sa=X&ved=2ahUKEwiO2KyQhbzuAhUMxBQKHxVWClkQ6AEwAHoECAEQAg#v=onepage&q=skrimshire%2C%20entomological%20transaction&f=false>
- Skýpala J (1978) K poznání motýlů československé části Cérové vrchoviny (Lepidoptera). Zur Kenntnis der Schmetterlingsfauna des tschechoslowakischen Teiles von Cérová vrchovina (Lepidoptera). Zprávy Československé Společnosti Entomologické při ČSAV 14: 115–118. [in Czech with German abstract]
- Smith ABT (2009) Checklist and Nomenclatural Authority File of the Scarabaeoidea of the Nearctic Realm including Canada, the continental United States, and the northern Mexican states of Baja California, Baja California Sur, Chihuahua, Coahuila de Zaragoza, Durango, Nuevo Leon, Sinaloa, Sonora, Tamaulipas, and Zacatecas. Version 4 – released 22 April 2009. Ottawa, 97 pp. <https://unsm-ento.unl.edu/SSSA/Nearctic-Scarabs4.pdf>
- Solomakha IV, Konishchuk VV, Mudrak OV, Mudrak HV (2020) A Study of the Emerald Network objects in Ukrainian Forest-Steppe of Dnieper Ecological Corridor. Ukrainian Journal of Ecology 10(2): 209–218. <https://www.ujecology.com/articles/a-study-of-the-emerald-network-objects-in-ukrainian-foreststeppe-of-dnieper-ecological-corridor.pdf>
- Sommer D, Hillert O, Hrůzová L, Král D (2021) *Bolbelasmus* (*Bolbelasmus*) *zagrosensis* (Coleoptera: Scarabaeoidea: Bolboceratidae), a new species from Iran, along with an updated key to the western Palaearctic species of the subgenus. Zootaxa 4920(3): 380–394. <https://doi.org/10.11646/zootaxa.4920.3.4>
- Sparacio I (1995) Coleotteri di Sicilia. Parte prima. L'Epos, Palermo, 233 pp.
- Spružina J (2016) Zápisky z terénního deníku: Banát 15.6.–16.6.2016. [Field diary notes: Banát 15.6.–16.6.2016]. Příspěvky k Ústecké Vlativědě 14: 33–35. [in Czech] http://www.muzeumusti.cz/CMSUpload/Clanek_1328/prispevky14%20web.pdf
- Staines CL, Staines SL (2020) An annotated checklist of the Coleoptera of the Smithsonian Environmental Research Center: the Scarabaeoidea. Banisteria 54: 87–98. https://virginianaturalhistorysociety.com/banisteria/pdf-files/ban54/An_annotated_checklist_Coleoptera_SERC_III_Staines.pdf
- Stan M, Nițu E (2013) New data on the knowledge of beetle fauna (Insecta: Coleoptera) in the “Bârnova-Repedea Forest” site of community importance (ROSCI 01235, Iași, Roma-

- nia). Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa" 56(1): 33–44. <https://doi.org/10.2478/travmu-2013-0003>
- Stebnicka Z (1976) Żukowate – Scarabaeidae. Grupa podrodzin: Scarabaeidae laparosticti. Klucze do oznaczania owadów Polski. Część XIX. Zeszyt 28a. [Beetles – Scarabaeidae. Subfamily group: Scarabaeidae laparosticti. Keys to the identification of insects of Poland. Part XIX. Volume 28a]. Państwowe Wydawnictwo Naukowe, Warsaw, 139 pp. [in Polish] https://baza.biomap.pl/pl/getpdf/KdOOP_Coleoptera_Scarabaeidae_laparosticti_cz_XIX_zesz_28a_nr_89.pdf
- Stephens JF (1829) A systematic catalogue of British insects: being an attempt to arrange all the hitherto discovered indigenous insects in accordance with their natural affinities. Containing also the references to every English writer on entomology, and on the principal foreign authors. With all the published British genera to the present time. Insecta mandibulata. Ordo I. Coleoptera. Baldwin & Cradock, London, xxxiv + [ii] + 416 + 388 pp. <https://doi.org/10.5962/bhl.title.8987>
- Stephens JF (1830) Illustrations of British entomology; or, a synopsis of indigenous insects: containing their generic and specific distinctions; with an account of their metamorphoses, times of appearance, localities, food, and economy, as far as practicable. Mandibulata. Vol. 3. Baldwin & Cradock, London, 374 + [5] pp. + pls xvi–xix. <https://doi.org/10.5962/bhl.title.8133>
- Stephens JF (1839) A manual of British Coleoptera, or beetles; containing a brief description of all the species of beetles hitherto ascertained to inhabit Great Britain and Ireland; together with a notice of their chief localities, times and places of appearances, etc. Longman, Orme Brown, Green, and Longmans, London, xii + 443 pp. <https://doi.org/10.5962/bhl.title.59227>
- Stierlin G (1900) Fauna coleopterorum helvetica. Die Käfer-Fauna der Schweiz nach der analytischen Methode. 1. Teil. Bolli & Böcherer, Schaffhausen, 667 pp. <https://doi.org/10.5962/bhl.title.8772>
- Stierlin G, Gautard V von (1867) Fauna coleopterorum helvetica. Die Käfer-Fauna der Schweiz. Stierlin & Gautard, Schaffhausen – Vevey, 372 pp. <https://www.e-rara.ch/zut/content/zoom/19074197>
- Sturm J (1805) Deutschlands Fauna in Abbildungen nach der Natur mit Beschreibungen. V. Abtheilung. Die Insecten. Erstes Bändchen. Käfer. Mit 20 illuminirten Kupfertafeln. Jacob Sturm, Nürnberg, 10 + xxxxi + 271 pp. + 20 pls. <https://doi.org/10.5962/t.173057>
- Sturm J (1843) Catalog der Käfer-Sammlung von Jacob Sturm. Mit 6 ausgemalten Kupfertafeln. Jacob Sturm, Nürnberg, xii + 386 pp. + 6 pls. <https://doi.org/10.5962/bhl.title.37837>
- Szél Gy, Kutasi Cs (2011) Bogarászati kutatások Csévharaszt és Vasad térségében (Coleoptera). [Research on beetles in the area of Csévharaszt and Vasad (Coleoptera)]. Rosalia 6: 303–351. [in Hungarian]
- Szlabóczky I, Borbás V (1900) Szabolcs vármegye állatvilága (Fauna). [Fauna of Szabolcs County]. In: Borovszky S (Ed.) Magyarország vármegyéi és városai (Magyarország monografiája). A magyar korona országai történetének, földrajzi, képzőművészeti, néprajzi, hadügyi és természeti viszonyainak, közművelődési és közgazdasági állapotának. Enciklopédiája. Szabolcs vármegye. [Counties and towns of Hungary (Monograph of Hungary). The history, geography, art, ethnography, military and natural conditions, culture and economy of the countries of the Hungarian crown. Encyclopaedia. Szabolcs County]. „Apollo” irodalmi társaság, Budapest, 245–252. [in Hungarian] https://adt.arcanum.com/en/view/Borovszky_Szabolcs/?pg=280&layout=s

- Szwałko P (2004) *Bolbelasmus unicornis* (Schrank, 1879). In: Głowaciński Z, Nowacki J (Eds) Polska Czerwona Księga Zwierząt. Bezkręgowce. Polish Red Data Book of Animals. Invertebrates. Instytut Ochrony Przyrody PAN, Kraków. [in Polish with English abstract] <https://www.iop.krakow.pl/pckz/opisc7fc.html?id=180&je=pl> [accessed 24 January 2021]
- Tatole V, Iftime A, Stan M, Iorgu E-I, Iorgu IŞ, Oţel V (2009) Speciile de animale Natura 2000 din România. [Natura 2000 animal species of Romania]. Imperium Print, Bucureşti, 174 pp. [in Romanian]
- Tenenbaum S (1923) Przybytki do fauny chrząszczów Polski od roku 1913. [Additions to the beetle fauna of Poland since 1913]. Rozprawy i Wiadomości z Muzeum Imienia Dzieduszyckich 7–8: 136–186. [in Polish] <https://rcin.org.pl/dlibra/publication/152779/edition/122396/content>
- Tesař Z (1954) Přehled československých druhů čeledi Geotrupidae. [Overview of Czechoslovak species of the family Geotrupidae]. Časopis Národního Musea, Oddíl Přírodovědný 123(2): 204–214. [in Czech]
- Tesař Z (1957) Brouci listoroží – Lamellicornia. Díl II. Scarabaeidae – vrubounovití. Laparosticti. Fauna ČSR 11. Nakladatelství Československé akademie věd, Prague, 326 pp. + 16 pls. [in Czech with German and Russian summaries]
- Török J (1882) Debreczen Rovarfaunája. [Insect fauna of Debreczen]. In: Zelizy D (Ed.) Debreczen szabad királyi város egyetemes leírása. [General description of the free royal city of Debreczen]. Városi Könyvnyomda, Debreczen [= Debrecen], 181–213. [in Hungarian] https://adt.arcanum.com/en/view/CsaladHely_MonografiaVaros_DebreczenSzabadKiralyiVarosEgyetemesLeirasa/?pg=198&layout=s
- Trach VA, Gontarenko AV (2005) Zhuki navozniki (Coleoptera: Scarabaeoidea: Troginae, Geotrupinae, Ochodaeinae, Aphodiinae, Scarabaeinae) Odesskoy oblasti. The dung beetles (Coleoptera: Scarabaeoidea: Troginae, Geotrupinae, Ochodaeinae, Aphodiinae, Scarabaeinae) of the Odessa region. Izvestiya Kharkovskogo Entomologicheskogo Obshchestva 12[=2004](1–2): 77–85. [in Russian with English summary]
- Trilar T (2019) (Ne)spre gledano iz Prirodoslovnega muzeja Slovenije. Bledi glivar (*Bolbelasmus unicornis*). [(Un)overlooked from the Natural History Museum of Slovenia. Earth-borer beetle *Bolbelasmus unicornis*]. Trdoživ 8(1): 29. [in Slovenian] <http://www.dlib.si/stream/URN:NBN:SI:doc-3LL5QXXK/1246b1ee-4bea-48db-874c-ff9875df6711/PDF>
- Trizzino M, Audisio P, Bisi F, Bottacci A, Campanaro A, Carpaneto GM, Chiari S, Hardersen S, Mason F, Nardi G, Preatoni DG, Vigna Taglianti A, Zauli A, Zilli A, Cerretti P (2013) Gli artropodi italiani in Direttiva Habitat: biologia, ecologia, riconoscimento e monitoraggio. Quaderni Conservazione Habitat. 7. Corpo Forestale dello Stato, Ufficio per la Biodiversità, Roma, 256 pp. https://www.mite.gov.it/sites/default/files/archivio/biblioteca/protezione_natura/artropodi_italiani_dir_habitat.zip
- Trnka F (2009) *Bolbelasmus unicornis* – chrobák jednorohý. [Earth-borer beetle *Bolbelasmus unicornis*]. [in Czech] <http://www.naturabohemica.cz/bolbelasmus-unicornis> [accessed 6 September 2021]
- Týr V (1997) Příspěvek k faunistice brouků nadčeledi Scarabaeoidea (Coleoptera) Čech, Moravy a Slovenska. Contribution to the faunistics of Scarabaeoidea (Coleoptera) of Bohemia, Moravia and Slovakia. Klapalekiana 33: 239–247. [in Czech with English abstract]
- Vasko BM (2009) *Bolbelasmus unicornis* (Schrank, 1789) – Bolbeliazm odnorohyi. [Earth-borer beetle *Bolbelasmus unicornis* (Schrank, 1789)]. In: Akimov IA (Ed.) Chervona knyha

- Ukrainy. Tvarynniyi svit. [Red Book of Ukraine. Fauna]. Hlobalkonsaltny, Kyiv, 111–111. [in Ukrainian] <https://redbook.land.kiev.ua/111.html>
- Vasko BM (2010) Fauna i ekologiya plastinchatousykh zhukov (Coleoptera: Scarabaeoidea) Pravoberezhnoy Ukrainy. Fauna and ecology of Lamellicornia beetles (Coleoptera: Scarabaeoidea) of the Right-Bank Ukraine. Izvestiya Kharkovskogo Entomologicheskogo Obshchestva 18(1): 4–86. [in Russian with English summary]
- Vasko BM, Bryhadyrenko VV (2011) *Bolbelasmus unicornis* (Schrank, 1789) – Bolbeliazm odnorohyi. [Earth-borer beetle *Bolbelasmus unicornis* (Schrank, 1789)]. In: Pakhomov OYe (Ed.) Chervona knyha Dnipropetrovskoi oblasti (Tvarynniyi svit). [Red Book of the Dnipropetrovsk Oblast (fauna)]. Dnipropetrovska oblasna derzhavna administratsiya, Dnipropetrovskiyi natsionalnyi universytet Olesya Honchara & Dnipropetrovska oblasna orhanizatsiya Vseukrayinskoi ekolohichnoi lihy, Dnipropetrovsk, 104–104. [in Ukrainian] http://pernatidruzi.org.ua/books/ck/ck_dnipropetrovks.pdf
- Verdú JR, Galante E, Lumaret J-P (1998) Description de la larve de *Bolbelasmus bocchus* (Erichson) et position systematique du genre. Annales de la Société Entomologique de France 34: 245–251. <https://gallica.bnf.fr/ark:/12148/bpt6k6136676b/f31.item>
- Verdú JR, Galante E, Lumaret J-P, Cabrero-Sañudo FJ (2004) Phylogenetic analysis of Geotrupidae (Coleoptera, Scarabaeoidea) based on larvae. Systematic Entomology 29(4): 509–523. <https://doi.org/10.1111/j.0307-6970.2004.00256.x>
- Vidlička Ľ (2011) Člankonožce. (Arthropods). In: Halčinová K (Ed.) Atlas druhov európskeho významu pre územia NATURA 2000 na Slovensku. The Atlas of Species of European Interest for NATURA 2000 Sites in Slovakia. Slovenské múzeum ochrany prírody a jaskyniarstva, Liptovský Mikuláš, 138–233. [in Slovak and English]
- Viertl A (1894) II. Természetráji rész. I. Pécs és környékének faunája. 3. Coleoptera, Lepidoptera. [II. Natural history. I. The fauna of Pécs and its surroundings. 3. Coleoptera, Lepidoptera]. In: Ágh T (Ed.) Emléklapok Pécs sz[abad] kir[ályi] város múltjából és jelenéből. [Memories of the past and present of the free royal city of Pécs]. József Taizs, Pécs, 39–72. [in Hungarian]
- Vovk DV, Sheshurak PN, Nazarov NV (2005) K izucheniyu plastinchatousykh zhukov (Coleoptera: Scarabaeoidea) Chernigovskoy oblasti Ukrainy. To the study of Scarab beetles (Coleoptera: Scarabaeoidea) of the Chernigov region of Ukraine. Izvestiya Kharkovskogo Entomologicheskogo Obshchestva 13(1–2): 35–42. [in Russian with English summary]
- Vovk DV, Sheshurak PN, Nazarov NV (2016) Plastinchatousye zhuki (Coleoptera: Scarabaeoidea) Chernigovskoy oblasti (Ukraina). The scarab beetles (Coleoptera: Scarabaeoidea) of Chernihiv Region (Ukraine). Ukrayinskyi Entomolohichniy Zhurnal 11(1–2): 91–98. [in Russian with Ukrainian and English abstracts] http://irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe?C21COM=2&I21DBN=UJRN&P21DBN=UJRN&IMAGE_FILE_DOWNLOAD=1&Image_file_name=PDF/Uej_2016_1-2_13.pdf
- Vrezec A, Pirnat A, Kapla A, Polak S, Vernik M, Brelih S, Drovenik B (2011) Pregled statusa in raziskanosti hroščev (Coleoptera) evropskega varstvenega pomena v Sloveniji s predlogom slovenskega poimenovanja. Status and knowledge about beetles (Coleoptera) of European conservation importance in Slovenia with proposal of Slovenian nomenclature. Acta Ento-

- mologica Slovenica 19: 81–138. [in Slovenian with English abstract] http://www2.pms-lj.si/pdf/Acta/AES_19-2_1_Vrezec.pdf
- Wachsmann F (1907) Pápa és vidékének bogárfaunája. [Beetle fauna of Pápa and its surroundings]. Rovartani Lapok 14: 11–23. [in Hungarian] <https://www.biodiversitylibrary.org/item/53352#page/15/mode/1up>
- Wallis JB (1928) Revision of the genus *Odontaeus*, Dej. (Scarabaeidae, Coleoptera). The Canadian Entomologist 60: 119–128, 151–156, 168–176. <https://doi.org/10.4039/Ent60119b-5>
- Westwood JO (1852) Descriptions of some new or imperfectly known Species of *Bolboceras*, Kirby. Transactions of the Linnean Society of London 21: 19–30 + pls 3–4. <https://doi.org/10.1111/J.1096-3642.1852.TB00496.X>
- Willimzik E (1930) Über den Bau der Ovarien verschiedener coprophager Lamellicornien und ihre Beziehung zur Brutpflege. Zeitschrift für Morphologie und Oekologie der Tiere 18(4): 669–700. <https://doi.org/10.1007/BF00418156>
- Zaharieva-Stoilova B (1974) Scarabaeidae ot Sredna i Istochna Stara planina. Scarabaeidae von dem mittleren und dem östlichen Balkangebirge. Izvestiya na Zoologicheskaya Institut s Muzei 41, 123–139. [in Bulgarian with German and Russian summaries]
- Zahradník P (2017) Seznam brouků (Coleoptera) České republiky a Slovenska. Check-list of beetles (Coleoptera) of the Czech Republic and Slovakia. Lesnická práce, Kostelec nad Černými lesy, 544 pp. [in Czech and English]
- Zandigiacomo P (2005) Nuovo rinvenimento di *Bolbelasmus unicornis* (Schrank) (Coleoptera, Geotrupidae) in Friuli Venezia Giulia. Bollettino della Società Naturalisti “Silvia Zenari” 29: 75–79.
- Zelený J (1972) Návrh členění Československa pro faunistický výzkum. Entwurf einer Gliederung der Tschechoslowakei für Zwecke der faunistischen Forschung. Zprávy Československé Společnosti Entomologické při ČSAV 8: 3–16. [in Czech with German abstract]
- Ziani S, Bezděk A, Krell F-Th, Sommer D (2021) Authorship and date of publication of the name *Scarabaeus stercorosus* (currently *Anoplotrupes stercorosus*) (Coleoptera: Scarabaeoidea: Geotrupidae). Zootaxa 5067(4): 593–599. <https://doi.org/10.11646/zootaxa.5067.4.7>
- Zilioli M, Pittino R (2004) Un reperto eccezionale: *Lucanus tetraodon* Thunberg in Lombardia (Coleoptera, Lucanidae). Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale in Milano 145: 301–306. <https://www.biodiversitylibrary.org/item/269606#page/303/mode/1up>
- Zoufal V (1922) Fauna brouků Prostějovského okresu. [Beetle fauna of the Prostějov district]. Věstník Klubu Přírodovědeckého v Prostějově 18: 5–21. [in Czech]